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USING "OTHER TRANSACTIONS" AS AN EFFECTIVE R&D CONTRACTUAL VEHICLE

by

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The Federal Government is no longer the preeminent market for high technology. With billions of dollars being spent in the commercial sector on Research & Development (R&D), the uniformed services cannot afford to be a non-participant in state-of-the-art technology due to the cumbersome and prescriptive practices of the standard procurement system. This thesis establishes the rationale for using "Other Transactions" (OT) authority as a contractual mechanism in the R&D arena. Background into the Defense Advanced Research Projects Agency's (DARPA) use of OTs is the main thrust of this thesis as they have been the predominant and most experienced user of this contractual vehicle since its creation in 1989. This thesis also presents the legislation that created OT authority and the background that established the need for it. Additionally, the analysis focuses on important elements that are fundamental in embracing the use of OTs. If increased utilization of this contractual vehicle by the Services can be achieved, it will facilitate current technology insertion into military systems and attract more resources for future high technology endeavors.

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USING "OTHER TRANSACTIONS" AS AN EFFECTIVE R&D CONTRACTUAL VEHICLE

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ABSTRACT

The Federal Government is no longer the preeminent market for high technology. With billions of dollars being spent in the commercial sector on Research & Development (R&D), the uniformed services cannot afford to be a non-participant in state-of-the-art technology due to the cumbersome and prescriptive practices of the standard procurement system. This thesis establishes the rationale for using "Other Transactions" (OT) authority as a contractual mechanism in the R&D arena. Background into the Defense Advanced Research Projects Agency's (DARPA) use of OTs is the main thrust of this thesis as they have been the predominant and most experienced user of this contractual vehicle since its creation in 1989. This thesis also presents the legislation that created OT authority and the background that established the need for it. Additionally, the analysis focuses on important elements that are fundamental in embracing the use of OTs. If increased utilization of this contractual vehicle by the Services can be achieved, it will facilitate current technology insertion into military systems and attract more resources for future high technology endeavors.

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I. INTRODUCTION

A. GENERAL

The Department of Defense (DoD) is in a dynamic and rapidly changing environment that affects not only the front line defense forces but, to an even greater magnitude, the infrastructure that supports it. With funding being cut back every year and ever-increasing competition for scarce resources, it is critical that the Federal Government procurement process change with respect to Research & Development (R&D) efforts in military systems. Advanced technologies must be acquired expeditiously in order to make the most capable systems available to the end user before time renders them less than state-of-the-art. DoD's process for buying military systems is characterized as cumbersome and expensive. It is general knowledge that it takes 16 to 18 years to field such a system. The "business as usual" mentality is not acceptable. (Murphy, 1995, p. 1)

The Cold War espoused that there were distinct, highly technological needs separate from those needs of the civilian sector. This separation is perceived to have been instrumental in the successful conclusion of the Cold War but is no longer a viable alternative in the face of an austere funding environment and ill-defined adversaries. The real separation between the military and civilian sectors is not differing needs for high technology but more appropriately, the unique business and administrative practices insisted upon by the Government. Commercial industry's willingness to accept these non-value added practices are exacerbated by the willingness of the Government to pay

for them. The procurement system is inundated with practices intended to ensure value as a primary objective for the Government. For example, a common practice is the Government paying contractors for implementing and practicing its own cost accounting standards when generally accepted accounting principles (GAAP) would suffice. A second example: Seven of eight large corporations surveyed by the General Accounting Office (GAO) revealed that they maintain two separate administrative structures and assign additional people to comply with Government mandates. (GAO, 1994, p. 4.2) Requirements such as this add little if any value to a procurement, especially when pursuing high technology. Consequently, spending millions on oversight mechanisms to save thousands certainly represents an antithesis to the objective of ensuring value.

Agility and responsiveness in the acquisition system are paramount in meeting the needs of the warfighter. These characteristics must be embedded within every aspect of military procurement to enable quick responses to such a diversity of potential new threats. Herein lies the paradigm shift: Rather than relying heavily on prescriptions, statutes, and regulations, "contracting officers and negotiators must come to rely on common sense and good judgement to craft agreements that achieve Government objectives collaboratively with industry and maintain the public trust". (Dunn, 1996, p. 36) Reducing Government oversight where practicable will attract the formidable players in the commercial R&D marketplace and allow for efficiencies and economies of scale. Although economies of scale are normally associated with production lines and manufacturing processes, they can also be achieved in R&D through lump sum payments, cost sharing and utilizing technologies already developed. The presence of efficiencies

and economies of scale are questionable with respect to the traditional way DoD has conducted its R&D efforts in the past, due to the higher costs associated with oversight mechanisms.

"Other Transactions" (OTs) represent a unique tool in the acquisition process that will enable the DoD to harness the latest in technological advances. OTs level the imbalances found in standard procurement, attracting once reluctant companies into non-traditional agreements with the Government that may not be possible otherwise. By using a vehicle without all of the requisite mandates, the DoD stands to gain much more in state-of-the-art military systems while fostering partnerships in pursuing cutting edge technologies. The use of OTs represents a fundamental and radical shift in both thinking and culture on the part of the Government. Their lack of prescription in procedures requires an expanded use of judgment and sound business sense by the contracting officer. Risks can still be mitigated and managed without reliance on specific written prescription, as has been demonstrated repeatedly and successfully by Defense Advanced Research Projects Agency (DARPA) in their technological endeavors. OTs are not so foreign in nature as might be first perceived by contracting personnel. They merely reflect the contractual relationships and responsibilities that are commonly found in industry-to-industry agreements.

This rapidly advancing technological age in which the DoD must thrive requires a fundamental shift in the cultural approach if it is to reap the rewards of the technological advances enjoyed by private industry. Thomas Jefferson best characterized the need to keep pace with the times in his letter to Samuel Kercheval:

> I am not an advocate for frequent changes in laws and constitutions, but laws and institutions must go hand in hand with the progress of the human mind. As that becomes more developed, more enlightened, as new discoveries are made, new truths discovered and manners and opinions change, with the change of circumstances, institutions must advance also to keep pace with the times. (Jefferson, 1816)

The major thrust of this thesis is to expose the OT vehicle to the rest of DoD contracting and acquisition personnel for future application in the procurement process. OTs are in keeping with the spirit and intent of Acquisition Reform and provide a stark contrast to the regulatory and perfunctory methods of the standard acquisition process. They are not touted as the answer to all procurements, but should be considered whenever remotely possible. A thorough examination of DARPA's use of OTs provides valuable insight as to how they can best be utilized.

B. AREA OF RESEARCH

In this thesis, the evolution and legislative history of OTs are investigated. Several agreements between DARPA and commercial industry are examined to identify the underlying objectives that resulted in the decision to use an OT. Additionally, these objectives will be examined to determine how a greater use of OTs in R&D and the procurement of advanced technologies could further streamline the acquisition cycle. Even though the use of OTs was expanded to all DoD agencies in FY 1993, research in DoD usage is limited with the exception of DARPA. DARPA crafted the language for OTs which was codified into law and is the major practitioner of OTs among Federal agencies.

C. RESEARCH QUESTIONS

This thesis is modeled around a primary research question and four subsidiary research questions, as stated below:

1. Primary Research Question

Can "Other Transactions" be a more effective acquisition vehicle in the development of state-of-the-art military systems than the process used under the standard procurement system?

2. Subsidiary Research Questions

- What is an "Other Transaction" and how is it different from a standard contract?
- What were the issues that led to the creation of "Other Transactions"?
- How is DARPA currently utilizing "Other Transactions"?
- To what extent are the individual Services using "Other Transactions"?

D. SCOPE

This thesis defines "Other Transactions" utilizing the language of the law and by defining it in the negative; that is what OTs are not. Defining OTs in the negative is important as there is vagueness in the language which gives rise to a wide interpretation. Additionally, this thesis examines the use of OTs within DARPA and assesses the effectiveness in tapping the commercial marketplace for high technologies that might not have been possible under the standard procurement system.

A limitation of this study is that research was conducted principally with DARPA and does not provide a significant perspective on the use of OTs by other DoD

components. As the Services and other agencies within DoD increase their usage of OTs it would prove valuable to provide that insight as well.

E. METHODOLOGY

Research data were collected through comprehensive literature reviews and in-depth interviews with DARPA's General Counsel, Contracting Officers, and Heads of Technical Offices. Primary considerations were examined in each agreement studied, revealing that no two OTs were exactly alike. They were crafted to the satisfaction of the participants involved.

Sources of literature reviews include law journals, various periodicals and publications, the U.S. Code, and the Internet.

F. ORGANIZATION OF THE STUDY

Chapter II of this thesis provides an introduction and background of the legislative history and modifications to OT authority. It includes a discussion of how previous attempts at using commercial items more extensively were impeded by the regulations and policies themselves.

Chapter III is a description of representative agreements crafted by DARPA using OT authority, and details significant differences between an OT and a standard contract.

Chapter IV provides an analysis of the decisions to use an OT as an acquisition tool instead of the standard procurement system.

Chapter V provides recommendations and conclusions, as well as identifies areas for future research.

G. BENEFITS OF THE STUDY

This thesis proves to be beneficial to Federal acquisition and contracting personnel by providing exposure to a procurement tool that is little known and has had limited use outside DARPA. It is also anticipated that this study of OTs and its various uses provide a foundation for incorporation into the curriculum at the Naval Postgraduate School.

II. BACKGROUND AND LEGISLATIVE HISTORY

A. INTRODUCTION

The dramatic shift from the Soviet Union as the known threat to unknown adversaries is forcing fundamental changes in the way DoD will acquire its weapon systems in the future. The Cold War R&D efforts were focused on fielding technically superior weapon systems whose performance could be quantitatively measured against the weapon systems of the Soviet Union. Performance was not considered as a tradeoff against cost in producing this superiority. Funding for weapon systems in this era was deemed a high priority and was nationally characterized as achieving "peace through strength".

In contrast, the austere funding environment that DoD is currently experiencing requires greater scrutiny in deciding what technologies to pursue and what weapon systems to field. In addition to large weapon platforms, more consideration is being given to smaller technical weapon systems to prepare for future conflicts, as evidenced by a recent agreement between the Naval Air Systems Command (NAVAIRSYSCOM) and the Hughes Aircraft Company. The agreement is for the development of Geospatial Registration of Information for Dismounted Soldier (GRIDS).

> GRIDS technology will enable individual soldiers to become individual sensors and utilize Naval Aviation resources as both communications relay nodes and as weapon targeting and launch platforms. (U.S. Department of Defense, GRIDS, 1997, p. 2)

This pursuit of smaller, high technology weapon systems requires a more flexible acquisition approach than those used in the past in posturing against the former Soviet

Union. The lengthy timeline associated with traditional weapon system development will not facilitate the expeditious delivery needed to ensure that conflicts are engaged with current state-of-the-art technology. "The DoD today has a need not just for technological superiority but for high performance at an affordable price" (Gansler, 1995, p. 183). In order to accomplish this, the DoD must push the edge of the performance envelope outward, but instead of paying more and more for each new system, it now has to use advanced technology in new products as well as in manufacturing and support to dramatically reverse the historic cost-growth curves. (Gansler, 1995, p. 183)

Performance is becoming increasingly important as a consideration as a potential tradeoff for affordability. The performance/cost decision can be partially mitigated if the lengthy acquisition process can be streamlined and cost savings achieved. In terms of overall costs, it is feasible to expect that some technological superiority and performance might be preserved if the cost of the means of acquiring a weapon system/component are reduced. (Dunn(1), R.) "If DoD cannot do this, the only alternative may be to shrink its force structure to dangerously low levels or settle for technological parity rather than superiority over potential adversaries" (Dunn(2), 1997, p. 35).

"For more than four decades, the military and geopolitical rivalry between the United States and the Soviet Union defined the global balance of power and served as a major driver of U.S. science and technology policy" (National Academy of Engineering, 1993, p. 52). Many of the resulting technologies during this rivalry were subsequently adapted in the commercial marketplace as "spin-off" applications. Today, however, this is not so much the rule as it is the exception. Many advanced technologies are being

developed and implemented well ahead of DoD's requirements, forcing their adaptation by DoD as "spin-on" applications. (National Academy of Engineering, 1993, p. 54) DoD's position is eroding as the primary leader in the R&D arena to the role of a primary consumer. Civilian technologies are often more advanced than those available to the military. (Dunn(3), 1997, p. 4) This role reversal makes it even more important for DoD to partner as much as possible with industry to reduce barriers, such as Government-imposed accounting and auditing practices, between the Government and potential high technology suppliers. (Dunn(1), R.) These Government-imposed practices represent additional costs and potential delays that cannot be afforded in the R&D arena. "Harnessing the nation's commercial industrial base to reduce defense costs and keep pace with technological advances is one of the key challenges the U.S. military faces over the next decade" (Morrocco, 1995, p. 56).

The declining budgets have placed pressure on the Services to field the highest quality weapon systems and supplies while concurrently developing new scales of efficiencies to conserve available resources.

> The Defense Science Board has calculated that the average time to field a major new system is 16 to 18 years. Such lengthy programs are inherently costly and make early estimation of accurate development, acquisition, and life cycle costs almost impossible. Evolving "requirements" drive costs with little constraint. (Dunn(3), 1997, p. 4)

A change in acquisition approach is needed in DoD's highly regulated purchasing system if it is going to field weapon systems more affordably in the current austere funding environment. Acquisition cycle time must also be greatly reduced to increase the likelihood of fielding systems with current technology inserted. (Ablard, J.) The

traditional "one size fits all" acquisition approach will not serve the DoD well in attempting to pursue the cutting edge of technology. (Dunn(3), 1997, p. 3)

B. THE GAP BETWEEN DoD AND INDUSTRY

Reforms have been implemented over the past two decades in an effort to ensure the proper expenditure of public funds and to streamline the acquisition process. These prescriptions, statutes, and contract requirements were created with the intent to regulate the quality of items, establish reasonable price controls, and foster competition. As a result, many private companies find these requirements too cumbersome, and not worth the added costs and risks involved in the technology arena to engage in business with the Federal Government. Some companies refuse to participate in Federal contracts over the issue of intellectual property and technical data rights alone. (Ablard, J)

> One of the major reasons that leading commercial firms are reluctant to contract for R&D with the Government is the fear of losing or tainting intellectual property that has been developed to provide for the future sales and new products of the firm. (Spreng, 1994, p. 2)

The General Accounting Office (GAO) revealed in a 1994 report to the Senate that "the Hewlett-Packard Company does not accept Government R&D funds in order to protect its technical data rights" (GAO, 1994, p. 6). The DoD can no longer afford to forego the potential defense benefits of the R&D efforts of a company like Hewlett-Packard. The separation between the commercial and defense industries has grown quite narrow with the end of the Cold War. This narrowing of the two industries has resulted in a significantly smaller number of defense-specific companies with which to conduct business. "The bottom line is that a significant share of the most valuable research and

product development activity in commercial companies is virtually unavailable to the Federal Government, despite potential benefits to both parties" (Spreng, 1994, p. 3). To this end, it is critical that DoD has the capability to attract business with non-traditional defense companies to take full advantage of the latest developments in technology.

The mandates found in standard contract terms and conditions are barriers for cutting-edge companies in developing and producing new, state of-the-art technology for the Federal Government. (Dunn(3), 1997, p. 4) Government-unique auditing and accounting practices, detailed product specifications, and specifically, Government rights to technical data have contributed substantially to deterring many commercial firms from doing business in the Federal sector. (Bolos, 1997, p. 5) These barriers make it incumbent upon the Government to reduce the myriad of obstacles and hurdles present in an effort to exploit the commercial marketplace for high technology. In testimony before the U.S. House of Representatives, Richard Dunn, General Counsel for the Defense Advanced Research Projects Agency (DARPA), asserts that "Government is no longer the market for high technology. Government technology developments must not only meet mission needs but do so affordably" (Dunn(6), 1995, p. 14). With commercial industry spending billions of dollars in R&D (Spreng, 1994, p. 2), the DoD can ill-afford to miss the high technology endeavors that are being undertaken in the private sector.

C. NEED FOR INTEGRATING THE INDUSTRIAL BASES

"Civilian technological advance, driven by global economic competition, is now pacing technological advance in many fields critical to the national defense, especially in respect to materials, components, and subsystems" (National Academy of Engineering,

1993, p. 53). As more companies are forced or opt out of the defense-specific business for more lucrative ventures in the commercial sector, it stands to reason that the DoD could be left with fewer sources for meeting their technological needs. In an effort to mitigate this effect, the DoD must reach out further into the commercial sector to attract talent. (Ablard, J.) This might very well mean adopting more commercial-like practices for its R&D requirements. In a 1991 report from the Center for Strategic and International Studies (CSIS),

> The U.S. defense industrial base is devolving into a small, highly specialized, highly subsidized, defense-unique sector that may soon be incapable of meeting the nation's fundamental security requirements: quantities of affordable equipment, access to and rapid fielding of cutting-edge technologies, and the ability to expand selected production when crisis conditions warrant. (Bingaman, 1991, p. x)

The CSIS report also identified possible consequences of a continued segregation of the industrial bases which include:

- Lower production volume resulting in higher unit costs.
- Limited capability for production surge resulting in greater reliance on foreign sources.
- Lack of access to state-of-the-art commercial processes and products.
- Inefficient split of the national pool of human talent.

A segregated industrial base was further perpetuated in the Cold War era due to large defense budgets and an abundance of defense-specific requirements. "In large measure, however, this split has been perpetuated not by technology needs but by unique business and administrative practices" (Dunn(4), 1996, p. 33). All but one of eight companies surveyed by the GAO in 1994 either separated their defense and commercial

administrative operations or assigned additional people to comply with acquisition requirements. (GAO, 1994, p. 2.) The rationale for this separation within a company is to accommodate Government business, while retaining commercial practices to remain competitive in the commercial marketplace. Often, the same production lines are used to make the same or similar items for their defense and commercial customers. (GAO, 1994, p. 4.1) The Government ultimately pays for this separate infrastructure, which may result in little or no added value to the tangible end product.

Maintaining this industrial base segregation represents additional costs that can be avoided by the Government. It could ultimately imperil national security by limiting the number of high technology companies with which to conduct business. (Bingaman, 1991, p. x) Given the current environment, it is incumbent upon the Services to tap the commercial marketplace for its capabilities in high technology, and utilize existing commercial products to the maximum extent practicable. With a continued decline of the defense industrial base, the alternatives are limited. DoD must harness a technological-intense commercial industrial base which will be difficult, at best, utilizing current prescriptions and mandates.

D. EFFORTS TO GO COMMERCIAL

Prior to the Federal Acquisition Streamlining Act (FASA) of 1994, several attempts were made in an effort to move away from rigid military specifications (MILSPEC) and utilize commonly available items, or "commercial-off-the-shelf" (COTS) items where feasible. (Bolos, 1997, pp. 5-6) In addition, the DoD's Non-Developmental Item (NDI) acquisition strategy was implemented to minimize

development efforts and focus on modifying existing subsystems and components with commercially available items. (OMB, 1976, p. viii) While reducing MILSPEC items and increasing usage of COTS and NDI provided some relief from excessive specifications, the reforms were encumbered with prescriptive processes by which the products had to be acquired. This diminished some of the benefits, such as cost savings, the reform efforts attempted to achieve. These reform efforts are evidence that the Federal Government has previously recognized that change was needed in the acquisition system in order to utilize commercial items to a greater extent. Past efforts to increase the utilization of commercial products included the following actions.

1. DoD Directive 5000.37, Acquisition and Distribution of Commercial Items (ADCOP), 1978

The ADCOP program encouraged contracting officers to acquire commercial supplies instead of items built to MILSPECS. The program was incorporated into the FAR when it was issued in 1984 but did not offer any incentives to buy commercial items. It was soon regarded as a policy statement. (Bolos, 1997, p. 5)

2. Office of Management and Budget (OMB) Report to Congress, 1982

OMB's report stated that reliance on Government-unique specifications for items that were commonly available in the commercial marketplace inhibited the purchase of commercially available items and services. No major remedial legislation resulted from this report. (Bolos, 1997, p. 5)

3. Competition in Contracting Act (CICA), 1984

CICA promotes the use of commercial items wherever practical. However, no special incentives or statutory waivers were offered. (Bolos, 1997, p. 5)

4. President's Blue Ribbon Commission on Defense Management (Packard Commission), 1986

The Packard Commission emphasized the benefits, such as shortened lead times and reduced costs, that would result from increasing the use of commercial items. It recommended greater use of COTS rather than MILSPECS. The commission also recommended statutory preference for commercial items and advocated the removal of statutory and regulatory impediments in the acquisition of commercial items. Commercial-style procurement competition was also recommended. (Bolos, 1997, p. 5)

In 1993, the Advisory Panel on Streamlining and Codifying Acquisition Laws (the Section 800 Panel) from DoD clarified that the largest impediments to buying commercial items were the prescriptions and statutes themselves (Bolos, 1997, p. 6). None of the recommendations or statutes provided the incentives or waivers necessary to facilitate an increased usage of commercial items. "The Panel proposed a broad new definition of commercial items (including ancillary services) and recommended that several procurement laws be waived for commercial item acquisitions". (Bolos, 1997, p. 6) This Section 800 Report and the National Performance Review were instrumental in the creation of FASA but did not address or provide the needed tools to streamline acquisition efforts in the R&D community.

E. THE NEED FOR AN ALTERNATIVE APPROACH

While efforts were underway to acquire more commercial items under the standard procurement system, DARPA had a need of its own. Grants and cooperative agreements authorized under the Federal Grant and Cooperative Agreement Act (1978), did not allow enough contractual freedom to engage the high technology entities in whom DARPA had developed a primary interest. Grants are to be used to stimulate or support a recipient, such as non-profit organizations and universities, in carrying out a project that supports a public purpose. (Bolos, 1997, p. 15) Cooperative agreements are to be used when there is a mutuality of interest, such as developing a technology for Government gain and use in a product to make a profit. (Bolos, 1997, p. 15) While cooperative agreements do not require the oversight of a standard contract, they are still subject to Federal mandates. "DARPA was only able to use cooperative agreements on a minor part of their overall program because the size of their contracting office was very limited" (Bolos, 1997, p. 14). As a result, DARPA missed numerous opportunities to contract with companies developing new technologies due to the manpower required in administering a cooperative agreement. (Bolos, 1997, p. 14)

> DARPA found that some of the most promising technical ideas were found in small start-up companies that were often made up of nothing more than the owners of intellectual property, the skills of their principals, and a few key employees. (Bolos, 1997, p. 14)

Additionally, the relationships that often needed to be established in DARPA's endeavors were consortium arrangements, which are not appropriate for standard Government contracts. "Procurement contracts require a prime contractor/subcontractor

relationship which is inappropriate for a consortium member that is not a separate legal entity" (Bolos, 1997, p. 14). Participants needed to be recognized as peers or co-prime contractors in an arrangement that could only be accomplished through a multi-party agreement.

During the 1988 Biennial Review required by the Goldwater-Nichols Act, DARPA's inability to enter into cost-sharing and cost-recovery agreements for the development of dual-use technologies was questioned. (Summerill, 1996, p. 5) It was recommended that DARPA be allowed to enter into "innovative contractual arrangements" that were in the best interests of the Government. Management consultant Robert Spreng concluded in his 1994 report that, "significant contractual changes are essential in both intellectual property and cost collection requirements if the Government is to tap the vast technological resources that are currently available from commercial firms" (Spreng, 1994, p. 1). This need for innovation in agreement authority to accommodate R&D endeavors gave rise to "Other Transactions", also known as Other Agreement Authority.

F. THE ADVENT OF "OTHER TRANSACTIONS"

In 1989, pursuant to 10 U.S.C. 2371, DARPA was granted the authority to enter into contractual agreements known as "Other Transactions" (OTs). Congress recognized the need to enhance the flexibility and reduce the administrative burden of Government-funded science and technology contracts. These OTs are not traditional procurement contracts and are not required to incorporate the statutes and regulations inherent in the standard acquisition process. Specifically, they are not required to comply with the Truth

in Negotiations Act (TINA), Cost Accounting Standards (CAS), Government property requirements, Government-unique subcontracting requirements, and the Federal Acquisition Regulation (FAR) and Defense Federal Acquisition Regulation Supplement (DFARS) cost principles. (Summerill, 1996, p. 6) Basically, an OT is a "clean sheet of paper" that has very few statutes and regulations with which to comply. "Statutes of general applicability, such as Title VI of the Civil Rights Act of 1964, are applicable" (Dunn(4), 1996, p. 35). This freedom from mandates has been instrumental in resolving critical intellectual property rights (IPR) issues with commercial industry. (Ablard, J.)

The legislative language was intentionally kept short and vague to provide DARPA with maximum flexibility to craft a common sense agreement, instead of relying on prescribed formulas and algorithms that might impede the true objective. (Dunn(1), R.) OTs were codified into law at PL 103-160 under experimental authority that was originally set to expire in 1992:

> The Secretary of Defense, in carrying out advanced research projects through the (Defense) Advanced Research Projects Agency, may enter into cooperative agreements and other transactions with any person, any agency or instrumentality of the United States, any unit of State or local Government, any educational institution, and any other entity. (10 U.S. Code 2371)

This authority was extended in the FY 1992-1993 National Defense Authorization Act and was amended to include "the secretaries of each military department, in carrying out advanced research projects" (10 U.S. Code 2371). The authority was to be used only "when the use of standard contracts or grants is not feasible or appropriate" (10 U.S.C. 2371). The statute also stipulated that equal cost sharing, and the avoidance of

duplication of effort, was to be utilized to the maximum extent practicable. "In an other transaction, the Government's financial support cannot exceed, to a "practical extent," the total amount contributed by its commercial partners" (Summerill, 1996, p. 5). DARPA's interpretation of the statute language is that there may be situations where equal cost sharing is not "practicable". This type of ambiguity in the language, and the lack of a precise definition as to when to use OTs, has been an obstacle for other components of DoD. (Ablard, J.)

Cost sharing in an OT arrangement is mutually beneficial in that the primary focus is based on the participant's self-interests, such as potential long-term profits and technological advancements, and not on Government oversight mechanisms. (Summerill, 1996, p. 5) "The commercial entity not only has a financial stake in the success of the project but is pressured from other participants in the case of a consortium to work more efficiently and effectively" (Summerill, 1996, p: 6).

> In OTs, all consortium partners, including the Government partner, are concerned with changing the project in such a way as to enhance project success rather than fee maximization. So, all investors, Government, and consortium members alike approach changes from a very different perspective than on a contract. The view is, 'How can we make changes that will achieve goals at the least possible cost for us all?' This is quite different from, 'How much cost estimate can I sell my Government customer that will reduce my risk and maximize my fee?' (Bolos, 1997, p. 38).

The majority of DoD procurement officials are uncomfortable with these new partnerships, as they represent a radical shift away from the Government's traditional oversight role. (Summerill, 1996, p. 4) They require an interpretation and understanding of the objective, and unique tailoring is required to meet the needs of all parties involved .

in the transaction. An OT's lack of specific structure, and the fact that no two are identical, has created confusion in their application. Even though OT authority was extended to the services in 1992, it was not until 1994 that they first exercised them. (Bolos, 1997, p. 19) "The services have not used OTs for research due to 10 U.S.C. 2371's conditions that they be used only when a standard contract, grant, or cooperative agreement is not feasible or appropriate" (DoD, 1996, p. 5). "Because of the uncertain nature of OTs, the Services retained authority for OTs at the service major command headquarters. This discouraged field activities from requesting or using OTs" (Bolos, 1997, p. 19). The services view OTs for research as vehicle of last resort. (DoD, 1996, p. 5)

G. "OTHER TRANSACTIONS" DEFINED

An OT is a contractual mechanism just as a standard procurement contract is a contractual mechanism. But where an OT differs greatly is that it is not a Government "contract" in the same sense of the word that a standard procurement contract is a Government "contract". An OT is not subject to the rules and regulations that govern a standard procurement contract; nor does an OT contain the terms and conditions that are typically included in a standard procurement contract. Understanding this difference is fundamental in embracing the OT concept. "Defining other transactions is complicated by the absence of the term in the Armed Services Procurement Act (ASPA), the CICA, the FGCA, the FAR, the DFARS, or any OMB guidance. (Summerill, 1996, pp. 4-5)

> There is no definition of an "other transaction." In a sense an "other transaction" is defined in the negative. It is not a standard procurement contract, grant or cooperative agreement. Thus, it is not subject to laws, rules and regulations that govern those instruments. Under 10 U.S.C.

> 2371, "other transactions" can be used to stimulate and support research and development and for other purposes but may not be used for the principal purpose of acquiring goods and services for the direct benefit or use of the Federal Government. (Dunn(5), 1996, p. 3).

10 U.S.C. 2371 specifies that OTs are to be used when standard contracts or grants are not feasible or appropriate. In accordance with the FAR, procurement contracts and grants are used "when the principal purpose is the acquisition of supplies and services for the direct benefit of the Federal Government" (FAR, 6: 35.003). While DARPA's activity with industry may produce goods and services that eventually provide direct benefit to the Government, the "principal purpose" is to partner with industry in stimulating and developing high technology with an emphasis on dual-use technologies. DARPA's interpretation of "principal purpose" allows it to use OTs more readily as contractual vehicles.

OTs are better characterized rather than attempting to define them: they are contractual vehicles that allow for a deregulated approach to Government-sponsored R&D. There are few constraints imposed by preordained rules and forms. There is no strict format or boilerplate by which to craft an OT. Common sense and good business judgement are the cornerstones in crafting an OT. (Ablard, J.) The most practical way to understand OTs and their use is to examine how DARPA has used them which will be illustrated in Chapter III.

H. SECTION 845 PROTOTYPE AUTHORITY

In the 1994 National Defense Authorization Act, OT authority under 10 U.S.C. 2371 was amended by Section 845 giving DARPA even greater capability with OTs.

Section 845 allows DARPA to conduct prototype development "directly relevant" to weapons and weapon systems. Section 845 authority was codified into law at PL 103-160 and was set to expire in 1996:

> The Director of the (Defense) Advanced Research Projects Agency may, under the authority of section 2371 of title 10, United Sates Code, carry out prototype projects that are directly relevant to weapons or weapon systems proposed to be acquired or developed by the Department of Defense. (10 U.S.C. 2371)

Section 845 under OT authority was amended in the FY 1997 Authorization Act to include "the Secretary of a military department, or any other official designated by the Secretary of Defense" (10 U.S.C. 2371). Congress also extended Section 845 authority until November 1999.

A significant change with Section 845 authority under OTs was the elimination of cost sharing in pursuing purely military R&D projects. Once again, the words "to the maximum extent practicable" appeared with respect to using competitive procedures which allowed some discretion and freedom. "Section 845's grant of authority is bounded by the definition of "prototype projects" and "weapons or weapon systems proposed to be acquired" (Dunn(5), 1996, p. 6). DARPA has interpreted "prototype projects" to mean prototypes which include projects of lesser scopes such as technology demonstrations, sub-system and component prototypes. The plain meaning of the language in Section 845 is extremely broad. The statute does not require that a prototype project be for the "development of a weapon", only that the project be "directly relevant" to weapons proposed to be acquired or developed. (Dunn(5), 1996, p. 7) "Weapons" is not construed as restricted to those weapons listed in the United States Munitions List;

other items of equipment may clearly constitute a weapon, and can be either offensive or defensive in character.

Whether or not DARPA is too liberal in its interpretations of the plain meaning of the words in the statute, one fact remains evident: They have crafted and executed agreements based on their interpretation of OTs, and they have successfully reported their results directly to Congress. Congress has been supportive in expressing their views of DARPA's actions.

> Statements in floor debate, as well as committee and conference reports, endorse DARPA's interpretation and use of this flexible authority. The interpretation of the effect of "other transactions" authority contained in this section may thus be viewed as ratified not only by Congressional statements but by Congress' act of appropriating millions of dollars in light of DARPA's application and interpretation of the statutes, and by Congress' reenactment of both 2371 and 845 with knowledge of DARPA's interpretation. (Dunn(5), 1996, p. 8).

DARPA is currently seeking legislative authority allowing a Section 845 prototype project to transition directly into production.

> While the authority may have usefulness to build X-planes and technology demonstrators, its real power will be demonstrated when a prototype project flows seamlessly into a production program preserving the innovations, schedule, and cost savings introduced during the prototype project. (Dunn(3), 1997, p. 5)

This authority, if granted, would greatly facilitate program decision making and production contracting. This would require the project to generate data such as life cycle costs to support a Defense Acquisition Board (DAB) or other official review prior to entering into a Milestone III decision. (Dunn(5), 1996, p. 11)

With prototype authority extended to the services and Congressional endorsement of DARPA's interpretation in the use of OTs, it follows that the services could exercise this authority to utilize OTs to the extent DARPA has. More frequent use of OTs in appropriate situations will accommodate further integration of the industrial base, achieve cost savings in reduced oversight mechanisms, and allow the services to fully experience the myriad of technological capabilities of the commercial marketplace.

I. SUMMARY

The Federal Government has long been aware that utilizing commercial products where feasible instead of generating unique requirements saves time and money. However, previous efforts to use commercial products and practices did not accommodate the R&D arena and its needs. With the decrease in the gap between the industrial bases, contractual agreements need to be selected to accomplish their objectives affordably. The DoD cannot afford to be a non-participant in high technology due to perfunctory and time consuming procedures that are present in the standard procurement system. Furthermore, the prescriptions and mandates required in standard procurement contracts represent significant barriers in conducting R&D with the Government. The use of OTs as a contractual mechanism allows DoD to tap the technological capabilities of the commercial marketplace to an even greater extent.

III. DARPA AND "OTHER TRANSACTIONS"

A. INTRODUCTION

DARPA was established as the Advanced Research Projects Agency (ARPA) in 1958 by an Executive Order of President Dwight D. Eisenhower, partly in response to the launching of the Soviet satellite Sputnik. The agency was created to operate independently of the three Services and was envisioned to be DoD's corporate research organization, capable of exploring the outer limits of advanced technology. (Davey, 1993, p. 1) DARPA's pursuit of innovative applications of new and emerging technologies has resulted in significant breakthroughs for the military as well as the commercial sector. (Davey, 1993, p. 1)

> DARPA's innovation is not limited to technology. They have pioneered many innovative contracting and management approaches and maintain a routine intimacy with the commercial sector. These two together have helped leverage commercial technology to provide both affordability and increased performance, as well as moving advanced capabilities into the hands of the warfighter more quickly. (Lynn, 1997, p. 2)

Perhaps the most famous example of DARPA involvement in prototyping dates back to 1961, when DARPA funded a field test of 1000 AR-15 rifles in Southeast Asia. "The M-16 subcaliber rifle would not have made it into the Army without DARPA sponsoring a test program of the M-16's predecessor, the AR-15, in Vietnam" (Dunn(4), 1996, p. 34) Other significant DARPA contributions to military technology include phased array radar, ballistic missile defense systems (which helped spawn the Strategic Defense Initiative), precision guided munitions, and stealth technology. (Davey, 1993, p.

1) DARPA is also credited for the material research that went into developing light-weight composites that have broad military and civilian applications, including both aircraft and bridge construction. (Morrocco, 1993, p. 42)

"John Deutch, the former Provost of the Massachusetts Institute of Technology, contends that the computer strength of the United States came out of DARPA" (Davey, 1993, p. 1). The agency also played an important role in the development of computer networking, the concept of local area networks (LANS), artificial intelligence, and parallel processing for supercomputers. (Davey, 1993, p. 1) The Internet as it is known today would not exist or have progressed at such a rapid pace, had it not been for the initial funding and development by DARPA. (Ablard, J.)

DARPA has also funded some expensive failures, such as an attempt to develop an experimental combination helicopter-airplane. The effort was canceled after spending nearly $200 million. Additionally, an effort to develop a system to guide combat vehicles over rough terrain using artificial intelligence was also dropped after a substantial investment. (Davey, 1993, p. 3) If an R&D effort is subsequently determined to be unfeasible, DARPA leaves the endeavor and goes on to something else. (Galatowitsch, 1991, p. 24) DARPA continually reviews its investments and terminates those efforts where payoff does not meet high expectations. (Lynn, 1997, p. 2)

Exercising the option of terminating an R&D effort, and gaining valuable insight from the experience, is fundamental to success in exploring cutting-edge technology. (Ablard, J.) The sight of an endeavor's true objective would be lost if termination for default penalties were automatically dispensed with unsuccessful efforts. The traditional

stigma associated with a "failure" does not permeate DARPA as has been seen within the other components of DoD. (Ablard, J.) Despite some unsuccessful efforts, "the project and program histories show that DARPA has made many highly significant contributions to defense technology and to technology of interest to the world in general"(Van Atta, 1991, p. S-1).

B. TYPES OF "OTHER TRANSACTIONS"

DARPA has entered into over 130 OTs since 10 U.S.C. 2371 granted such authority in 1989. The majority of the OTs have been multi-party agreements with multiple signatures or with one company acting as an agent for the members of a consortium. (Dunn(6), 1995, p. 7) Some projects and technology developments are best suited for a single-party agreement as illustrated by DARPA's very first OT with Gazelle Microcircuits.

> The agreement with Gazelle would accelerate the development of a new class of gallium arsenide communication components. DARPA had previously helped establish the U.S. manufacturing capability for digital gallium arsenide products. The purpose of DARPA's technical and funding support under the agreement was to establish a secure, low-cost, assured source of supply for a key advanced technology for defense needs. (Dunn(6), 1995, p. 8)

Gazelle had never had a Government contract before and possessed neither the accounting systems nor infrastructure required to perform a standard procurement contract. What they did possess though was the technology and capability that DARPA envisioned as critical for future DoD applications.

DARPA's initial report to Congress provided the following types of the OT agreements that were expected to be entered into.

1. Bailment

"This would involve the lending or borrowing of equipment typically with a sharing of research or test results" (Dunn(6), 1995, p. 8).

2. Parallel or Coordinated Research

"This would involve sponsoring a research project that is related to one or more research projects funded by others and involving an arrangement to share results or to coordinate the research to enhance the end result of each project" (Dunn(6), 1995, p. 8).

3. Consortia Agreements

> This would involve an agreement with multiple parties, when those parties have agreed to join together to perform research as a consortium. The consortium may not be a legal entity with the power to contract. A contractor or grantee/sub-contractor relationship may not be appropriate (Dunn(6), 1995, p. 8).

4. Joint Funding

"This would involve an arrangement with others to finance a third party to conduct research" (Dunn(6), 1995, p. 8).

5. Reimbursable Arrangements

> This may involve DARPA providing services such as transportation services on a DARPA experimental space launch vehicle, experimental air vehicle, or experimental undersea vehicle. The user would typically provide one or more of its own experiments to be conducted during a test mission. The amount of reimbursement to DARPA could be fixed depending on the extent to which the user's experimental data is to be shared with DARPA and the extent to which it supports a DARPA program (Dunn(6), 1995, p. 8).

DARPA's OTs have involved one or more aspects from the types with the exception of the reimbursable arrangement which involved a satellite ground station rather than a vehicle. (Dunn(6), 1995, p. 8)

C. "OTHER TRANSACTIONS" VERSUS STANDARD CONTRACTS

In order to be able to use an OT as an effective acquisition tool, distinctions must be drawn between OTs and standard contracts. An understanding of the advantages and limitations is fundamental in deciding to use an OT over a standard contract as a contractual mechanism. The intent of OTs is not to subvert or replace standard contracts. They provide an additional acquisition tool whose tangible benefits are best realized in an R&D effort. (Ablard, J.) Some of the key areas that warrant comparison are:

1. Ability to Terminate

Unlike a FAR contract, the DARPA model for an OT contains the provision that the Government or the consortium may terminate the OT for convenience provided that (a) written notice is preceded by consultation between the parties, and (b) that a reasonable determination is made that the project will not produce beneficial results that are commensurate with the expenditures of resources. (Kuyath, 1995, p. 547) Under a standard contract, the Government may terminate for convenience or default based on a unilateral decision with the contractor having a right to appeal. (FAR, 52.249-6) This is a significant departure in that the Government no longer has sole autonomy in deciding to terminate a contractual arrangement. But with an OT focused on the business relationship and the objectives of the arrangement, it is prudent to allow the consortium the ability to decide the feasibility of further pursuing the technological advances

originally conceived in the arrangement. The consortium's decision to terminate might be due to the technology being beyond the current state-of-the art or that the total financial contributions are not sufficient to continue.

In entering into an OT, consortium members have substantial interest and investment in seeing the original objectives accomplished. Exercising termination rights without adequate justification is highly unlikely. Abandoning the effort represents a loss of capital invested and the loss of potential future profits in the commercial marketplace.

2. Dispute Resolution

The Contract Disputes Act of 1978 applies to standard contracts. Claims arising from disputes must be certified by the contractor and submitted within six years of accrual. The contracting officer must render a contracting officer's final decision (COFD), which is final unless the contractor appeals to the Board of Contract Appeals (BCA) or files suit. Additionally, the contractor must continue performance pending resolution and the Government must pay interest if the claim is upheld. Alternative Dispute Resolution (ADR) is encouraged to increase the opportunity for relatively inexpensive and expeditious resolution of issues in controversy. (FAR, 52.233-1)

In contrast, DARPA's model OT requires that claims arising from disputes must be raised within three months from the date of accrual, do not require certification, and the Government shall not be liable for more than the aggregate amount of its funding disbursed at the time the dispute arises. Under an OT, the Contract Disputes Act does not apply, and the agreement does not stipulate that the contractor is required to continue performance pending resolution. It also specifies the sequential form in which disputes

will be resolved: (1) joint contractor/Government decision, (2) majority vote of a Senior Review Board consisting of officials from both parties, and (3) the Director of DARPA or appointed designee whose decision will be final and binding to the maximum extent permitted by law. (HDSS, 1995, p.13) Additionally, DARPA is not liable for consequential damages, interest, and claims for lost profits. (HDSS, 1995, p. 14)

Although the terms for dispute resolution may be negotiated under an OT, DARPA requires the consortium to demonstrate a compelling reason for using a different resolution method. (Kuyath, 1995, p. 550) The dispute process and its stipulations under an OT are significantly more streamlined in terms of time limitations and the amounts that may be sought by the contractor. The more stringent requirements and low-level resolution forums allow for a much more expeditious handling of disputes that may arise. Generally, time is of the essence in resolving disputes accurately, and is a critical factor in the time-sensitive technology arena. In the author's opinion, these resolution parameters established under an OT discourage anything less than an extremely difficult issue to be raised as a dispute. It also encourages resolution by lower echelons.

3. Patent Rights

Under a standard contract, the contractor can elect to retain all rights to inventions provided that the contractor disclose subject inventions within two months after deliberate invention, or within six months after discovery that a subject invention has been made, whichever is sooner. If the contractor elects to retain title, the Government shall have a irrevocable, nonexclusive, nontransferable, paid-up license to practice the invention throughout the world on its behalf. Provisions are established for Government

march-in rights, if the contractor fails to reduce the patent to practical application in the field of use and within a reasonable timeframe. In the event the Government retains title to a subject invention, the contractor retains a royalty-free license which extends to domestic subsidiaries and affiliates. (FAR, 52.227-12)

The Patent Rights clause set forth in an OT is similar to the standard FAR 52.227-12 which is based on the Bayh-Dole Act. DARPA requires a compelling business justification from a consortium to impose further limitations on these rights. The significant difference between patent rights clause in an OT and a standard contract is the absence of paragraph (g) of FAR 52-227-12. This paragraph provides that

> The subcontractor shall retain all rights provided for the prime contractor in the clause and the prime contractor shall not, as part of the consideration for awarding the subcontract, obtain rights to the subcontractor's subject inventions. Language similar to paragraph (g) has been interpreted as prohibiting grant-backs to the prime contractor of even a nonexclusive license in the subcontractor's subject inventions. (Kuyath, 1995, p. 551)

If a restriction similar to paragraph (g) were included in an OT, it would be inconsistent with the goals and objectives of the agreement. The consortium members are to develop new technologies and intellectual property rights to strengthen and broaden the U.S. technological and industrial bases and make the members more competitive in the marketplace worldwide. (Kuyath, 1995, p. 552) If a restriction such as paragraph (g) were included in an OT, consortium members would be required to negotiate separate licensing agreements with their subcontractors with no guarantee that they would be successful.

> It would be inequitable to saddle the consortium members, which are obligated to share costs under the program, with the specter of future license negotiations and the potential inability to practice the technology

that they helped pay to develop if they are unsuccessful in their licensing negotiations. (Kuyath, 1995, p. 552)

The significant difference between patent rights under an OT and a standard contract is that it allows the consortium members to establish equitable ownership of patent and intellectual property rights without the Government having to impose mandates upon them. This allows the Government to remain as a neutral which is conducive in attracting high technology companies back for repeat business in Government-sponsored R&D. This modified hands-off approach to patent rights also allows for natural competitive forces in the marketplace which is to the Government's advantage in both acquiring high technology products for military systems and furthering technology in the civilian sector.

The DARPA model for an OT is included as Appendix A to this thesis. An actual OT agreement crafted between DARPA and Holographic Data Storage Systems (HDSS) is presented as Appendix B to this thesis.

DARPA's model OT serves as a framework when crafting an OT. In addition to the characteristics previously discussed, (1) it addresses the scope of an agreement, which includes a vision statement that is not characteristic of a standard contract; (2) management of the project in which roles and relationships of consortium and Government are defined; (3) obligations and payments; and (4) other administrative matters that are necessary in any contractual arrangement.

The OT model is not all inclusive of the issues that may arise between the Government and commercial companies. Common sense and good business judgement

should allow for additions and deletions to the model whenever they serve the best interests of the participants involved. (Ablard, J.) Many provisions under the statutes and regulations that govern standard procurement contracts may appear in an OT, not because they are required, but because there are instances where they make good business sense and are agreeable to the participants.

D. EXAMPLES OF DARPA'S "OTHER TRANSACTIONS"

1. Arsenal Ship

"The Arsenal Ship is a joint Navy/DARPA program conducted under Section 845 to develop the concept for fleet evaluation and to accelerate Navy acquisition reform by developing and demonstrating industry's ability to design future Navy ships" (Dunn(2), 1997, p. 38). "The sole "requirement" was a militarily useful production ship with a unit sail-away price (USP) of $450 million and an absolute maximum price of $550 million" (Dunn(2), 1997, p. 39). As a result, industry has shown considerable enthusiasm in being able to trade performance, schedule, and cost. Tradeoffs have to be made with the USP and $550 million as focal points. (Bolos, 1997, p. 53)

The Concept of Operations (CONOPS) document consists of four pages and addresses objectives such as a variety of missiles (about 500), extended forward operations, joint command and control, survivability, and low life cycle costs to include a crew of less than 50. (U.S. Department of Defense, CONOPS Document, 1996, pp. 3-4) The ship capabilities document (SCD) consists of five pages which includes performance objectives that the Navy considered requisite to satisfy the concept of operations. Items such as aviation support, fuel type, and buoyancy and stability are addressed. (U.S.

Department of Defense, SCD Document, 1996, pp. 2-5) The SCD and CONOPS are not requirements but rather the objectives for Arsenal Ship and have been expressed in less than a dozen pages instead of thousands that might result under a traditional shipbuilding program. (Dunn(2), 1997, p. 39)

The Arsenal Ship program consists of six phases with the last two phases consisting of options for actual production and life cycle support. Phases consist of: I, concept design; II, functional design; III, demonstrator detail design and construction; and IV, performance testing and management of fleet evaluation. (Dunn(2), 1997, p. 39) Phase I agreements were awarded on July 11, 1996 to five industry teams for $1 million each. This was accomplished in two months from the date that the CONOPS was formally issued. "This is a remarkable schedule for a major warship" (Dunn(3), 1997, p. 4) Phase II downselect from five to three teams occurred in January 1997 with Phase III downselect to one team to occur in February 1998.

One of the significant and beneficial outcomes already realized as a result of the Arsenal Ship program was in the area of Vertical Launch Systems (VLS). (Ablard, J.) Lockheed-Martin has dominated VLS with its MK-41 launcher for a number of years. With industry teams developing combat systems as well as the Arsenal Ship itself, it allows for competition and entry into a market that was previously cost prohibitive. (Ablard, J.) "Variations of the standard MK-41 VLS and entirely new launchers were proposed" (Dunn(2), 1997, p. 39). The end result of opening the market for VLS has resulted in a 40% decrease in the price and significant reductions in life cycle costs of the

MK-41. The industry teams involved with Arsenal Ship envisioned the future DD-21 class destroyers as the follow-on market for new VLS designs. (Ablard, J.)

"The Arsenal Ship's significance in its technological advances and the acquisition reform process is more important than it is to lead to a new class of warships" (Schwiering, D.). It will specifically be able to demonstrate automation systems that effectively reduce crew size by a factor of ten, vastly improved survivability in comparison to other Navy ships through radically reduced radar signatures and passive protection features, a more capable VLS system with an open architecture for modifications and improvements, and the connectivity needed to achieve inter-service operability. (Schwiering, D.)

It should be noted that the Arsenal Ship program was canceled while this thesis was being composed due to political and funding issues.

2. Tier II+ Global Hawk Unmanned Aerial Vehicle (UAV)

"DARPA, in conjunction with the Defense Airborne Reconnaissance Office (DARO), is developing an unmanned aerial vehicle, Tier II+, that will provide surveillance information to the warfighter" (Dunn(2), 1997, p. 37) The program is in response to the recommendations of the Defense Science Board (DSB) and to the operational needs stated by DARO on behalf of the military service users. (Sommer, 1997, p. 1) A few performance objectives were identified and solicited but they were not mandated. They were listed as goals that could be traded against the one system characteristic that was a firm requirement: a unit flyaway price (UFP) of $10 million per air vehicle for vehicle numbers 11-20. (Sommer, 1997, p. 4)

Global Hawk is a Section 845 program that involves Advanced Concept Technology Demonstrations (ACTD), using mature technologies. DARPA involvement and the flexibility of Section 845 authority was needed as "UAV and tactical surveillance/reconnaissance programs have a history of failure due to the inadequate integration of sensor, platform, and ground elements, together with unit costs far exceeding what the operator has been willing to pay" (Sommer, 1997, p. 1). "Past experience indicates that the program cost goals have not been met because initial performance expectations were demanding and constraining. That approach left little room for design trades in the critical, early program phases" (Sommer, 1997, p. 1). In this program, the DARPA/DARO paradigm is "tell the contractors what we want, not how to do it" (Dunn(2), 1997, p. 38).

Global Hawk consists of four phases. Phase I was a competitive effort with five contractors, out of a total of 14 proposals, receiving $4 million in DARPA funding based on their capability and approach to the project. (Bolos, 1997, p. 51) The solicitation was released in May 1994 with Phase I awards occurring in early October of the same year. Negotiations for Phase I were completed in November. "This in itself is remarkable as Tier II+ is a significant airframe roughly the equivalent to a U-2" (Dunn(2), 1997, p. 38). "Teledyne Ryan won the Phase II award in May 1995 to design and build two complete air vehicles including payload and one complete ground segment with flight tests" (Bolos, 1997, p. 51). Even though the program is conducted under OT authority through Section 845, Phase II is a cost plus incentive fee (CPIF) arrangement with a target price of $157 million. (Bolos, 1997, p. 51)

Comments from industry participants involved in Phase I competition were uniformly positive about the new way of doing business. Some of the participants clearly premised their approach on a commercial style while others made only minor adjustments to their business as usual. (Dunn(2), 1997, p. 38) "Substantial reductions in overhead costs have been claimed by some teams. Most teams have reported substantial achievements in subcontracting, relating to both lowered prices and hard commitments" (Dunn(2), 1997, p. 38).

Phase III will involve the contractor building several operational test vehicles and two ground systems, provide logistic support, and conduct a two year field demonstration. "The objective of Phase III is the successful operational demonstration and the completion of all tasks to enable the UFP in the production phase" (Dunn(2), 1997, p. 38).

Teledyne Ryan rolled out the first Global Hawk aircraft in February 1997 after only 21 months from signing the Phase I agreement. (Swatloski, R.) "By contrast, Teledyne Ryan's most recent previous effort on UAVs under the traditional procurement system took 53 months from contract award to rollout for a much smaller aircraft" (Dunn(2), 1997, p. 38) Global Hawk is scheduled for first flight in the November-December timeframe of 1997.

3. Interferometric Synthetic Aperture Radar For Terrain Elevation (IFSARE)

"The Interferometric Synthetic Aperture Radar for Terrain Elevation (IFSARE) technology is an airborne, all weather, day/night, radar-based terrain mapping technology

which offers the potential to revolutionize the mapping industry worldwide" (U.S. Department of Defense, IFSARE, 1995). The technology was developed under contract with the Environmental Research Institute of Michigan (ERIM) and the Army Topographic Engineering Center (TEC) to meet the need for improved map products. Despite DARPA efforts to transition the IFSARE system to an operational Government agency after development, no Government agency stepped forward and offered to take the financial responsibility of approximately $1-1.5 million per year to maintain the system. (Meyrowitz, B.) Forecasts indicated that even if the IFSARE system were fully operational, the projected level of Government use did not justify maintaining the system as a Government asset. (U.S. Department of Defense, IFSARE, 1995)

ERIM was convinced that a viable domestic and international market existed for IFSARE products based on their own extensive market contacts and a study conducted by KPMG Peat Marwick for NASA in 1991. (Meyrowitz, B.) ERIM's offer was to establish a commercial business to offer IFSARE products to commercial, civilian, and Government customers worldwide. This commercialization was a viable alternative compared to allowing the IFSARE system to sit idle in a Government warehouse due to a lack of program funding to continue operational and maintenance (O&M) support. (Meyrowitz, B.)

DARPA made the decision to transition the IFSARE system to ERIM with DARPA recouping the entire fee and cost of money ($1.3 million) that had been paid to ERIM under the TEC development contract. In addition, the Government would receive the "best customer rate" that ERIM offered less the depreciation up until the value of

IFSARE had been depreciated ($4.8 million) or ten years, whichever happened first. (Meyrowitz, B.) Other significant benefits that were to accrue to the Government include:

- the Government will continue to have long-term, quick-reaction, priority access to the IFSARE System to support military and civilian national emergencies;
- the Government will not be required to incur direct costs in order to maintain the quick-reaction capability;
- the Government will benefit from the improvements to the technology which are driven by the commercial market;
- the Government will be assured of the best available pricing for the products it requires because of the competition inherent in the commercial market; and
- the U.S. will benefit from being the global leader in the deployment of IFSARE technology. (U.S. Department of Defense, IFSARE, 1995)

The original objective was to allow ERIM use of the IFSARE system until they were commercially viable or they would have to return it to DARPA within approximately three years. ERIM showed that they would have spent over $1 million per year just to maintain the system and in five years would have invested as much as the cost of the system. It was agreed upon that one of two events must occur for ERIM to obtain title: 1) ERIM would reach breakeven and maintain a profit for two consecutive quarters or 2) five years will have passed at which time the machine would have been paid for. (Meyrowitz, B.)

Given the situation and circumstances, this arrangement provided a win-win solution for both the Government and ERIM. (Meyrowitz, B.)

E. SUMMARY

DARPA's innovation and technical contributions to the military and commercial marketplace preceded the creation of OTs. The creation of OT authority gave DARPA even greater flexibility by broadening the spectrum of potential R&D participants. The versatility of the OT instrument is demonstrated through some of DARPA's current agreements that (1) utilize advanced technology development (Arsenal Ship), (2) employing mature technology with the use of ACTDs (Global Hawk), and (3) as a business partnership or bailment (IFSARE) to recoup initial investments.

IV. ANALYSIS OF "OTHER TRANSACTIONS"

A. INTRODUCTION

DARPA's endeavors in pursuing cutting edge technologies for the DoD as well as promoting technological advances within the private sector have been enhanced through the use of OTs. Due to the perceived flexibility of an OT, companies such as Hewlett-Packard are more willing to participate in federally funded projects, without the fear of losing autonomy over their intellectual property and data rights. With virtually no statutes and regulations to comply with, an OT really begins with a "clean sheet of paper" and creates an optimum environment that benefits both industry and Government. However, crafting a suitable agreement in this environment requires extraordinary business acumen, in order to preserve and protect the best interests of the Government and its OT partner(s).

RADM Richard Ginman, Office of the Assistant Secretary of the Navy, Research, Development and Acquisition (ASN RD&A), Director for Acquisition and Business Management (ABM), opined that "Other Transaction authority is one of the most exciting things I have seen in my 27 years in the Navy" (Ginman, R.). He also warned that they are fraught with peril when exercised by personnel who possess anything less than adept business skills and sound judgement. In order to analyze the appropriateness of an OT in an R&D endeavor, the following question must be considered first: What is the Government trying to accomplish?

B. UNDERSTANDING THE OBJECTIVES

In order to determine whether an OT should be used for an R&D effort, the decision maker must understand and focus on the objectives of the requirement. In doing this, the proper acquisition vehicle can then be selected commensurate with the requirement. As will be discussed, OTs can accomplish objectives that the standard procurement system cannot, but consideration needs to be given to all of the available acquisition vehicles to facilitate making the best decision. While OTs allow much more freedom than the acquisition tools under the standard procurement system, this facet alone does not make them the best choice in all R&D endeavors. Remaining focused on the objectives will allow for the best acquisition vehicle selection.

A classic example of using the wrong acquisition vehicle in an R&D effort is the Navy's catastrophic A-12 bomber program. (Lamm, D.) In addition to a lack of communication (Ginman, R.), a significant factor in the failure of the program was in using a firm-fixed price (FFP) contract in an R&D environment. An FFP contract is better suited for the production environment, where risks and costs are quantifiable and an end product can be delivered. Many of the structural design features and composite material characteristics that were being sought by the Navy in the A-12 program had not been developed. Therefore, the associated costs and risks were mostly unknown. (Ablard, J.)

An FFP contract is not suitably flexible to overcome the often inherent difficulties associated with advancing state-of-the-art technology. It follows that had the focus remained on developing the technologies that were needed to produce a prototype of the

A-12, some type of cost reimbursement (CR) contract would have been appropriate as the acquisition vehicle. A CR contract would have allowed the feasibility of the project to be determined as technological progress and discoveries were made. Instead, the Government opted for an FFP contract which required that a deployable airplane had to be delivered. As it turns out, the A-12 would have never flown anyway due to the critical design flaws discovered well after the contract was terminated and the program abandoned. (Ablard, J.) The end result of the A-12 program was zero airplanes delivered and litigation that continues at present.

The Space and Naval Warfare Systems Command (SPAWAR) recently defined and established the R&D objectives of the Multifunctional Information Distribution System (MIDS) for sonar systems. This resulted in a decision to use OT authority under Section 845. The decision to use an OT was made when it was determined that none of the acquisition vehicles under the standard procurement system would adequately support the objectives. (Nurse, C.) The objectives for MIDS were twofold. First, SPAWAR wanted to gain current technology insertion into MIDS, an objective that could be accomplished by drastically reducing the acquisition cycle time associated with traditional weapon systems development. This objective could have been potentially accomplished under the standard procurement system if the effort were sole-sourced. However, sole sourcing the item was not justifiable when deemed not to be in the best interests of the Government.

The second SPAWAR objective was to award agreements to multiple companies in order to create competitive market forces to drive down the price for MIDS. Varying

levels of assistance in the form of cost sharing would be provided, based on the previous amount of MIDS experience a given contractor possessed. In the solicitation, SPAWAR offered up to $1 million in cost sharing to companies with significant MIDS experience, and up to $5 million to companies with little MIDS experience. (Nurse, C.) This objective could not be accomplished using traditional Requests For Proposals (RFP) under the standard procurement system. The RFPs would have had to treat the offerors in the same manner, a requirement which would have precluded the varying levels of experienced-based assistance envisioned by SPAWAR.

The MIDS competition resulted in awarding agreements to two companies out of a field of eight offerors. SPAWAR officials were extremely pleased with the results, as well as with the prospect of spawning competitive markets for the Government to utilize as technology resources in the future. They also expressed enthusiasm for OTs as a flexible acquisition tool in the R&D arena, but cautioned that the use of OT authority should be guarded and carefully scrutinized to ensure proper use. SPAWAR is currently exploring other potential areas that are suitable for using OT authority. (Nurse, C.)

DARPA and the Hughes Aircraft Company entered into an OT agreement to explore the feasibility of remote design capability. This consisted of design work being accomplished at a remote facility, and then controlling the actual fabrication and assembly at a production facility via computers and networking. The objectives were to overcome the previous logistical perception that design and production efforts had to be centrally located, and to realize cost savings in the process. (Knoski, J.)

Hughes leveraged this technological success to win the contract for the follow-on missile to the AIM-9X Sidewinder. The heat seeking, air-to-air Sidewinder has been manufactured by the Raytheon Corporation for well over a decade and was virtually unchallenged by competition. Hughes felt they did not stand a chance in winning the contract for the next generation Sidewinder if they could not set a prototype missile down on the table with their proposal, which is exactly what they did. (Knoski, J.) Hughes used the technology gained in the remote capability effort to design and subsequently build the electronics bay of the missile in approximately 30 minutes. This effort was successful in increasing the performance capabilities and reducing the overall costs of the missile, thus enabling Hughes to enter the market and effectively compete against Raytheon for the Sidewinder contract.

While the objective of the OT agreement was not the development of an advanced missile, the development of the remote capability technology was fundamental in its improved design. Since the contract arrangement was performed under an OT instead of the standard procurement system, the flexibility in the Statement of Work (SOW) readily allowed changes as discoveries were made and the research progressed. This attribute was instrumental in redirecting the efforts of the development, thus allowing Hughes to leverage the technology into a prototype missile much more quickly than they perceived they could have under a standard contract. Again, "laying the missile on the table" with the proposal was critical in Hughes displacing Raytheon as the AIM-9X provider. (Knoski, J.)

C. LANGUAGE INTERPRETATION

10 U.S.C. 2371 language is very broad and has considerable latitude in its interpretation. DARPA has liberally interpreted the statute language, enabling selection of OTs as their acquisition tool of choice for many contractual arrangements. Even though DARPA's endeavors with OTs and their interpretation of the statute language have been praised by Congress, it does not necessarily imply that the Services can or will adopt the same interpretation and use OTs similarly to DARPA.

Statute language must be carefully studied by senior leaders and needs a general consensus view before it can be applied accordingly. It is much easier to reach a consensus view in a small organization the size of DARPA than it is in a bureaucratic infrastructure like the Services. The consensus interpretation within the organization is fundamental in deciding whether to fully exploit or minimize the use of OTs. With the Services being traditionally more conservative in nature than DARPA, it will take time and a much greater effort to reach the same interpretation that DARPA has, if at all. Some of the language that is ripe for multiple interpretations follows:

1. "Prototype"

Reference to "prototype" is found in the legislative language under Section 845 of OT authority. Determining what is meant by "prototype" starts fundamentally with the definition contained in the dictionary.

> The standard dictionary classifies "prototype as a noun and defines it as "an original model on which something is patterned" and also as "a full-scale and (usually) functional form of a new type or design of a construction (as an airplane). The engineering definition of "prototype" is "a model suitable for use in complete evaluation of form, design, and performance". (Dunn(5), 1996, p. 6)

Statutory language does not reference any other intended meanings for "prototype". This would imply that applying the defintions found in the dictionary are appropriate. Additionally, projects of lesser scope such as technology demonstrations would qualify for "prototyping" in absence of specific restrictions. (Dunn(5), 1996, p. 6) Testing of existing technologies and their subsequent evaluation would qualify for prototyping even though immediate tangible products did not result. A good example to examine as a "prototype" is the Global Hawk agreement where new technologies were not explored or developed. The prototyping was involved with the ACTDs in hopes of eventually designing an affordable UAV. Even if Global Hawk never produced an airframe for further testing and evaluation, the program would still have qualified as a "prototype" project.

2. "Principal Purpose"

OTs are prohibited in the statutory language from being used for the "principal purpose" of acquiring goods and services for the direct benefit of the Government. The "principal purpose" in buying established products, such as repair parts for Government-unique equipment, would preclude the use of an OT. However, if technological advances were warranted and commercial applications existed for those same repair parts, the "principal purpose" may lie in partnering with industry to stimulate and develop the technology to improve or create a second generation of advanced parts. Even with tangible goods eventually resulting to the DoD from such an endeavor, the "principle purpose" would substantiate an OT as the contractual mechanism.

The follow-on AIM-9X Sidewinder missile developed by Hughes is a good example where the "principal purpose" of the OT agreement was in developing remote manufacturing and design capability. The missile was a result of the advancement of the technology but was not the intent of the agreement.

3. "Feasible or Appropriate"

OTs are to be used when contracts, grants, or cooperative agreements are not "feasible or appropriate". Paramount in making this determination is whether the deciding organization can conclude that the same objective can be accomplished under the standard procurement system. If an objective is to attract new technological talent that is unwilling or unable to participate under a standard contract or to create a competitive market for a technology, an OT is more appropriate and feasible in accomplishing the objective. Focusing on the objective will allow "feasible or appropriate" to be easily determined.

The SPAWAR Section 845 MIDS agreement illustrates where a vehicle under the standard procurement system was neither feasible nor appropriate. Offering varying levels of assistance based on previous MIDS experience was clearly an objective that could not be undertaken with standard RFPs. In using a standard procurement instrument, all of the offerors would have to be given the same consideration.

Additionally, the IFSARE agreement with ERIM to commercialize a developed mapping system was not appropriate for a standard procurement vehicle. The audit and accounting requirements would have been cost prohibitive to ERIM in undertaking the project. (Meyrowitz, B.) It was in the best interests of the Government to use an OT as a

bailment, in order to recoup the investment in IFSARE technology and establish preferred customer rates. The other alternative was to allow IFSARE to sit idle in a Government warehouse.

4. "Directly Relevant"

"Directly relevant" appears in Section 845 prototype authority in reference to carrying out pilot technology programs that are not only directly relevant to weapons, but to weapon systems as well. Interpreting what is actually meant by "directly relevant" probably has the broadest latitude of all the vague language in 10 U.S.C. 2371. For example, is the prototyping of training, simulation, auxiliary and support equipment directly relevant to a weapon system? If the administrative functions for a weapon system require unique computer data bases, do they qualify for prototyping under Section 845? If the language is interpreted to include the preceding requirements, it would give rise to a plethora of OT uses under Section 845. An organization must determine just how far removed from the weapon system development efforts can be. "Directly relevant" does not need to be an item that bolts directly onto a weapon or a support system that sits in the immediate perimeter of the weapon; it merely needs to be "directly relevant" and worthy of the prototype concept.

The NAVAIR agreement with Hughes in developing GRIDS illustrates the concept of "directly relevant". GRIDS is not a standalone weapon system, but its development will better enable the ground warfighter to utilize Naval aviation assets against an enemy. GRIDS is physically removed from the weapon system that will

deliver the strike. However, it will allow airstrikes to become more timely and effective through improved communication and identification of adversarial targets.

D. COST SHARING

OTs are required by 10 U.S.C. 2371 to cost share. The Government's share cannot exceed the combined contributions of its commercial partners to the maximum extent practicable. Cost sharing is not required under Section 845 authority, as its purpose is for purely military research. The concept behind cost sharing is that in developing a technology with dual-use, industry participants will have the future opportunity to commercially market these discoveries for a profit. It would not be an equitable arrangement, nor would it lend itself to a judicious use of taxpayer money, for the Government to fully fund an R&D effort that could be used to increase a participant's competitive advantage in the commercial marketplace. In essence, the participant would be incurring the benefits without incurring the costs associated with the technology development.

Equally sharing costs benefits the Government by reducing the Government's financial burden in an R&D effort. However, strict adherence to equal cost sharing might preclude the development of a critical technology. For example, if the commercial partner is a small company that does not have the capital or in-kind contributions such as independent research and development (IR&D) and intellectual property to cost share equally. (Ablard, J.) In these instances, a greater benefit to the Government might lie in acquiring the intellectual know-how of the company through greater assumption of cost sharing by the Government.

SPAWAR took an innovative approach and exercised good business judgement in cost sharing for the MIDS project, even though cost sharing was not required under Section 845 agreements. They recognized that cost sharing was equitable with MIDS, due to the fact that there were potential applications for the technology developments in the commercial marketplace. It was envisioned by SPAWAR that the successful offerors should incur part of the costs in the MIDS project if the potential existed to realize profits from the developments in the private sector.

Cost sharing can be regarded as a test of commitment on the part of industry participants in an OT. Companies that envision future markets in a technology development will be willing to invest their capital jointly with the Government. "Putting your money where your mouth is" encourages participants to put forth their maximum efforts in a project and focus on the objectives as they have future stakes to be realized in the form of profits and market share. In essence, it provides a form of guarantee, in that only the "best of the best" will come to participate in Government R&D. It also provides the incentives needed for reducing overall costs, while concurrently gaining the benefit of R&D at half-price. This is an OT feature that is particularly attractive, especially in a period of declining budgets.

E. EDUCATION AND TRAINING

In the author's opinion, education and training programs need to be established on OT concept and execution in order to exploit the potential benefit OTs have in acquiring R&D. Throughout the author's research, it was difficult at best to find fellow acquisition personnel who knew what OT authority was or even knew that it existed. With the

exception of DARPA personnel, the few that had heard the terminology could not engage in a conversation about OTs in any great detail. Those that were informally surveyed conveyed enthusiasm about the existence of a nontraditional acquisition tool that could be used to meet the unique objectives that occur in the R&D environment. The majority of these attempts to discuss OTs occurred at the Naval Postgraduate School (NPS), an important source of the Federal acquisition and contracting management education.

Significant entities within the commercial sector, such as the Boeing Aerospace Company, expressed confusion about the various uses of OTs and their advantages and disadvantages. (Hennen, T.) Through education and training, both Government and industry personnel would possess a better knowledge of OT authority and allow for its judicious use in appropriate situations. The biggest obstacle to be overcome in using OTs is the crafting and administration of an OT agreement. Due to the lack of specific structure in an OT, great care and consideration must be exercised by those possessing extraordinary business sense in order to ensure value to the Government. (Ginman, R.) Without exposure to additional discussion of the OT concept, the Government and industry acquisition community will fail to realize the potential of OTs.

F. SUMMARY

This chapter analyzed significant aspects of OTs that are critical in deciding to use an OT for R&D instead of a standard procurement instrument with specific examples cited. The organization must establish and remained focus on the objectives of the endeavor and an interpretation of the broad legislative language is necessary in determining a conservative approach in OT use or in pushing the edge of the acquisition

envelope. Additionally, cost sharing needs to be equitable between the Government and industry based on the potential of future markets in the commercial sector. And finally, education on OT authority is paramount if the Government is to realize the potential benefits they offer in the R&D environment.

V SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

A. INTRODUCTION

The primary purpose of this research was to explore "Other Transactions" authority and create exposure to Federal procurement personnel, and how its use can benefit the DoD in acquiring state-of-the-art technology for military systems in the face of continually declining budgets. The research questions addressed below were crafted to fulfill this purpose and the answers provide summary of the research.

B. RESEARCH QUESTIONS AND ANSWERS

1. Identification

What is an "Other Transaction" and how is it different from a standard contract?

An OT is in essence a "blank sheet of paper" that is free of the prescriptions and mandates that govern a standard contract. Statutes of general applicability, such as Title VI of the Civil Rights Act of 1964, are binding on an OT. The requirements of CICA, FARA, FASA, TINA, the FAR, and the DFARS that must be complied with under a standard contract do not apply. This freedom of prescription allows an OT to be crafted to the mutual satisfaction of commercial industry and the government and often resembles the terms and conditions found in an industry-to-industry contractual agreement.

An OT requires cost sharing to the maximum extent practicable between the government and its industry partners. The government's share is not to exceed fifty percent of the total amount contributed. An exception to cost sharing is Section 845

prototype authority. Section 845 is an OT but it is to pursue the development of prototypes for purely military use. Under a Section 845 OT, the government is allowed to fund the entire project without contributions from industry. Standard contracts do not have provisions for cost sharing or partnering in the manner an OT does.

Some of the features that make an OT arrangement particularly attractive to industry revolve around the issue of intellectual property rights and data rights. OTs have the capability of allowing participants much more autonomy over their intellectual property which has reduced some of the reluctance of commercial companies to enter into contractual arrangements with the government. Standard contracts are required to comply with the Bayh-Dole Act which gives the government the right to allow other contractors, including competitors, to produce a particular item for sale to the government. As an illustration, Hewlett-Packard previously refused Government R&D funds under standard contracts in order to protect their technical data rights. With the advent of OTs, the DoD through DARPA, has benefited from the private R&D investments of Hewlett-Packard by creating terms and conditions that were mutually agreeable. This is an instance of how an OT allowed the DoD to tap the commercial marketplace for technology where a standard contract was previously a deterrence.

OTs are specifically to be used to stimulate and support R&D and for other purposes but may not be used for the principal purpose of acquiring goods and services for the direct benefit or use of the Federal Government. The intent of OTs is to foster the development of technologies that have applications in both military and commercial environments as well as establish future resources of supply. Standard contracts are

concerned primarily with the interests of the government and supply availability in the current environment.

2. Issues

What are the issues that led to the creation of "Other Transactions"?

With the end of the Cold War, the defense and commercial industrial bases have narrowed significantly resulting in a smaller number of defense-specific companies with which to conduct business. With less technology being developed exclusively for the government, DARPA needed the means to attract and create partnerships with non-traditional defense companies in the R&D environment. It was recognized that a significant share of the most valuable research and product development activity in commercial companies was virtually unavailable to the Federal Government. This lack of availability was exacerbated by the unique business and administrative practices of the DoD under the standard procurement system. DARPA had realized that harnessing a technologically-intense commercial industrial base would be difficult if not impossible utilizing the prescriptions and mandates of a standard contract.

Without the capability to integrate the industrial bases, national security could be imperiled by limiting the number of high technology companies with which to conduct business. This continued segregation could lead to a loss of surge capacity, lower production volumes with higher unit costs, greater reliance on foreign sources, a lack of access to state-of-the-art processes and products, and an inefficient split of the national pool of human talent.

Additionally, GAO surveys revealed that companies separate their commercial and defense administrative operations or assign additional people just to comply with acquisition requirements. These separate infrastructures are ultimately paid for by the government resulting in additional costs that add little or no value. In the face of declining budgets, these added costs of doing business were deemed unaffordable, especially in an R&D environment.

An OT was envisioned as a contractual arrangement that would reduce the costs of doing business and contribute to the technological advances in the commercial marketplace. It would allow the use of commercial practices and create an atmosphere of partnering to allow the focus to remain on the objectives of the business deal instead of the intensity and requirements of a contractual mechanism.

3. DARPA Utilization

How is DARPA currently using "Other Transactions"?

DARPA has engaged in over 130 OTs since the authority was created in 1989. Some of the most significant projects that exhibit the versatility of an OT are the Arsenal Ship, Tier II+ Global Hawk unmanned aerial vehicle (UAV), and Interferometric Synthetic Aperture Radar for Terrain Elevation (IFSARE).

a. Arsenal Ship

The Arsenal Ship is a project of great magnitude sponsored jointly by the Navy and DARPA to demonstrate industry's ability to design future Navy ships. The sole hard requirement is a unit sail-away price of $450 million with an absolute ceiling of $550 million. The ship capabilities document (SCD) and the concept of operations

(CONOPS) were submitted as objectives versus requirements and were expressed in less than a dozen pages instead of the thousands that result from a traditional shipbuilding program. Phase I agreements were issued to five industry teams in just two months from the date of the formal solicitation. This alone exhibits that an OT can expedite the cycle time in major weapon systems acquisition.

A significant outcome of the program that was recognized very early was with the vertical launch systems (VLS). With industry teams designing the combat systems as well as hull structure, new VLS designs were created allowing entry into a market that had been dominated by Lockheed-Martin and their MK-41 launchers. Variations and modifications of the MK-41 ensued and completely new VLS systems were proposed. As a result, a 40% decrease in price of the MK-41 and reductions in life cycle costs were realized for VLS. This opened a virtually closed market with new competition and created the potential for incorporating these new designs on future Navy ships.

All of the potential in advanced shipbuilding designs and the acquisition reform process will not be realized in the Arsenal Ship program. Arsenal Ship was canceled prematurely due to funding and political issues.

b. Tier II+ Global Hawk

Global Hawk is a Section 845 program which utilizes advanced concept technology demonstrations (ACTD) instead of new technology developments. UAV programs had a history of failure due to inadequate integration of sensor, platform, and ground elements. This resulted in escalated costs that the Services were not willing to

pay. Program cost goals were not met due to excessive performance expectations that were demanding and constraining. Little room was left for design tradeoffs in the early, critical stages of previous UAV programs.

Global Hawk had one firm requirement: A unit fly-away price (UFP) of $10 million per air vehicle for vehicle numbers 11-20. Performance objectives were identified and solicited but not mandated. Teledyne Ryan won the award and rolled out the first Global Hawk just 21 months from signing the Phase I agreement. In contrast, Teledyne Ryan's most previous effort with UAVs under the standard procurement system took 53 months from contract award to rollout for a much smaller aircraft. Global Hawk is comparable in size to a U-2 airframe.

c. IFSARE

IFSARE is an airborne, all weather, day/night, radar-based terrain mapping technology that offers the potential to revolutionize the mapping industry worldwide. The technology was developed jointly with the Environmental Research Institute of Michigan (ERIM) and the Army Topographic Engineering Center (TEC) to meet the need for improved map products.

DARPA was unable to transition the system to another government agency and was left with the financial responsibility to maintain the system if it were left in operation. Forecasts indicated that there was not enough government use to justify maintaining IFSARE as a government asset. As a result, DARPA used an OT as a bailment and crafted an agreement with ERIM to establish a commercial business to offer IFSARE products to commercial, civilian, and government customers worldwide. The

OT would allow DARPA to recoup the costs of investment and establish favored customer rates for use of the system. If ERIM could not create market viability, the IFSARE system would be returned to the government.

This business arrangement provided a win-win situation for both the contractor and the government. The other alternative was to let the IFSARE system sit idle in a warehouse with the technological advancements not utilized.

4. Service Utilization

To what extent are the individual Services using "Other Transactions"?

Even though OT authority was granted to the Services in the FY 1992-1993 National Defense Authorization Act, the services did not use them premised on the condition that they be used only when a standard contract, grant, or cooperative agreement is not appropriate or feasible. Due to the uncertain nature of OTs, the authority to use them was retained at service major command headquarters which effectively discouraged field activities from requesting their use.

Section 845 prototype authority under OTs was granted to the services in the FY 1997 Authorization Act and has resulted in a better response to OT use than when the authority was initially granted. There is evidence that the Services are embracing the OT concept in R&D efforts more readily than they have been previously. Naval Air Systems Command (NAVAIRSYSCOM) has entered into a Section 845 agreement with Hughes Aircraft for the GRIDS system while the Space and Naval Warfare Systems Command (SPAWAR) has implemented the OT strategy to specifically promote competition and

gain current technology insertion into the Multifunctional Information Distribution System (MIDS) for the end user.

Even with Service use of OT authority being limited at present, expectations are that a significant increase in OT utilization will occur over the next couple of years and warrants further study and data collection. The Services have been experimenting with Section 845 projects for less than a year which is an inadequate period of time to draw significant conclusions about how many varied applications they will be utilized for in the future.

5. Effectiveness

Can "Other Transactions" be a more effective acquisition tool in the development of state-of-the-art military systems than the process used under the standard procurement system?

OTs are a valuable acquisition tool for R&D efforts in that they significantly reduce the cycle time that is traditionally associated with weapon system development under a standard procurement contract. This is evidenced by the Arsenal Ship and Global Hawk programs. The time that actual development efforts began from the time the formal solicitations were issued for the projects was expressed in two and four months respectively. Arsenal Ship was to have a functional demonstrator in the water by 2000 and the first Global Hawk rolled out onto the tarmac 21 months after beginning development. The Global Hawk contractor experienced 53 months to rollout on a previous UAV effort under a standard contract.

A reduction in the time cycle within any phase of an R&D effort is conducive to cost savings in the overall project. Due to the prescriptions and mandates that govern the standard procurement system, the timeline is much more difficult to shorten because so much more emphasis is placed on the process of contracting the R&D effort. OTs are focused on the objectives of the business deal instead of the processes that are intended to accomplish those objectives. Under a standard contract, the process can impede the objectives due to the lack of flexibility.

The advances in technology are being developed at a rapid pace. Time and the availability of talent are the substantial factors in ensuring that state-of-the-art weapon systems are fielded to the warfighter. Fundamental to this is being able to conduct business with the collective pool of high technology entities, not just those entities that can meet the requirements to perform a standard contract. OTs remove the barriers, such as audit and accounting oversight mechanisms, that have created reluctance among some high technology companies and allow smaller companies that are not administratively structured for government procurements to participate. Being able to tap the commercial marketplace in its entirety for high technology is critical in achieving superiority on the battle field. An OT is a contractual mechanism that will allow the DoD to achieve this goal more effectively.

C. RECOMMENDATIONS

In addition to encouraging major systems command to explore the potential use of OTs in R&D, the following recommendations are provided:

1. Vision

The DoD should provide an overall vision of the use of OT authority in the R&D arena. Instead of specific prescriptions and mandates which impede flexibility, DoD should allow major systems command to establish their own procedures and guidance on using OTs that are tailored to their individual requirements. Reporting feedback and documentation on lessons learned should be forwarded to a central location with the intent of eventually establishing unified direction, but at present, due to the lack of familiarity with OTs, unified direction is not realistic.

2. Information Collection Point

The establishment of a central information collection point should be explored within DoD to maintain data files of OT agreements and the strategies developed in order to provide information to those activities that are contemplating their use. Practical knowledge of actual OT agreements and points of contact could be made available to assist in the decision making process. Knowledge about OT use should not be fragmented and compartmentalized.

3. Formal Education

While the business skills and judgement critical in using OT authority is difficult to teach, personnel in the acquisition and contracting field need to be aware that such a valuable acquisition tool exists. The author discovered that OT authority existed by happen-chance and pursued to educate himself on the issue while at the Naval Postgraduate School (NPS). It would be greatly beneficial for OTs to be incorporated into the curriculum at NPS. Due to the lack of formal guidance that has been issued on

OTs, case studies could be analyzed for why an OT better met the needs of an R&D effort instead of a standard contract. Establishing education on OTs would provide some background and better prepare the student for his/her entry into the acquisition field.

D. AREAS FOR FUTURE RESEARCH

"Other Transactions" authority is receiving more attention as an acquisition tool within the Services. Regardless of whether the interpretation of OT use is conservative or more liberal, the advantages they offer in the R&D arena are significant. As the services become more familiar with OTs, it would be beneficial to examine how they have been utilized. Specifically, the following areas warrant analysis:

1. Individual Service Use

How have the individual services incorporated OT use into their R&D efforts and what are the respective policies and guidelines that have been developed and implemented to govern their use?

2. Industry Participation

How many new or small entities have been attracted into DoD R&D endeavors as a result of the use of OTs and has the availability of the new-found talent resulted in technological advances that may have not been realized using standard contracts?

3. Productivity and Costs

How has the role of the Government as a partner versus an oversight administrator increased productivity and reduced the overall costs of an R&D effort when using an OT as the contractual mechanism as opposed to a standard contract?

4. Education

How have the services embraced the use of OTs and what steps have the services taken to incorporate training and education on the use of OTs for their procurement personnel?

APPENDIX A. THE DARPA MODEL FOR AN "OT"

1. Article I: Scope of Agreement

"This article anticipates the development of a vision statement that describes the purpose of the agreement, the technology involved, and the commercialization goals" (Bolos, 1997, p. 27). This is in addition to the government's project description and the project description submitted by the offeror. The authority is cited for an OT and the term "best efforts" appears just as in a cost-plus-fixed-fee (CPFF) arrangement but in a different context. "Best efforts" is tied to payable milestones in an OT where specific events must be achieved in order to receive payment. Payments under a CPFF arrangement are usually made as progress payments based on expenditures by the contractor in the endeavor. (Bolos, 1997, p. 27) Article I also specifies cost share in terms of actual amounts for both government and the industry team. If either DARPA or the industry team is unable to provide its respective total contribution, the other party may reduce its project funding by a proportionate amount. (U.S. Department of Defense, HDSS, 1995, p. 6)

2. Article II: Term

The number of months are specified for the arrangement but states that if all of the funds are expended prior to the end of the term, then the parties have no further obligation to continue performance. Termination for convenience lies with either DARPA or the industry team as long as it is accomplished by written notice and submitted preceding consultation between the parties. (Bolos, 1997, p. 27) This latter

provision is in great contrast to a CPFF arrangement wherein termination for convenience lies solely with the government.

3. Article III: Management of the Project

"The agreement among consortium members defining the business arrangement among themselves is commonly referred to as Articles of Collaboration" (Bolos, 1997, p. 27). This article provides for an initial planning process and management by a Consortium Management Committee (CMC) and DARPA program managers. Major changes to the Articles of Collaboration such as new consortium members or change in cost share must be approved by DARPA. (Bolos, 1997, p. 28)

4. Article IV: Agreement Administration

This article lists the representatives by name for administrative and contractual matters as well as for technical matters. A Consortium Administrator for Payable Milestones is established who is responsible for paying respective consortium members when payment is received from DARPA. (Bolos, 1997, p. 28)

5. Article V: Obligation and Payment

This article requires that the consortium must maintain an accounting system which complies with GAAP. This is premised on the assumption that the records will contain the level of relevant detail that is acceptable in commercial practice. Article V also stipulates that no indirect costs can be incurred by the consortium nor will they be allocated to the government due to the consortium's status as a "conduit". Upon completion of each payable milestone, reports are submitted by the consortium and

validated by DARPA through the Program Managers who then notifies the Contracting Officer to process payment. (Bolos, 1997, pp. 28-29)

6. Article VI: Disputes

Disputes are to be resolved by negotiation and mutual agreement. If negotiation is unsuccessful, the aggrieved party may request a joint decision of the DARPA Deputy Director for Management and a representative of the CMC who shall make a joint decision. If joint decision cannot be reached, an appeal is to be made to the Director of DARPA who will make a final and binding decision to the extent permitted by law. (Bolos, 1997, p. 29) "The Contracts Disputes Act of 1978, which is applicable to FAR-covered procurement contracts, does not apply to disputes arising under the other transaction" (Bolos, 1997, p. 29).

7. Article VII: Patent Rights

This clause contains many of the provisions found at FAR 52.227-12. The FAR provisions are based on the Bayh-Dole Act but unlike a standard contract, the ability to negotiate these provisions is a primary reason that an OT is used rather than a cooperative agreement. "Preferences for U.S. Industry" and government "March-In Rights" similar to the FAR provisions are also included under this article. (Bolos, 1997, p. 29)

8. Article VIII: Data Rights

"The DARPA model includes data rights provisions that are much easier to comply with and more equitable to contractors than DFARS technical data and computer software regulations and clauses for FAR-covered contracts" (Bolos, 1997, p. 30). The government obtains government-purpose rights (GPR) to data since there is mixed

government/contractor funding under an OT. "DARPA can exercise march-in rights primarily if the consortium has not taken effective steps to achieve practical application of the technology developed during the performance of the OT" (Bolos, 1997, p. 30).

9. Article IX: Foreign Access to Technology

This article places control on access by foreign firms and institutions to important technology developments. The principal economic benefit of DARPA research efforts must be the domestic economy. (Bolos, 1997, p. 30)

10. Article X: Civil Rights Act

This is the only socioeconomic clause contained in the DARPA model which requires the consortium to comply with the Title VI of the Civil Rights Act of 1964. The consortium is required to provide certification to this effect but there is no requirement to flow the clause down to subcontractors. (Bolos, 1997, p. 31)

11. Article XI: Order of Precedence

This clause provides a hierarchy of resolving inconsistencies between the terms of the OT and the Articles of Collaboration. They are (1) the OT, (2) attachments to the OT, and (3) the consortium's Articles of Collaboration. (Bolos, 1997, p. 31)

12. Article XII: Execution

> "This merger clause provides that the OT constitutes the entire agreement of the parties and supersedes all prior and contemporaneous agreements, understandings, negotiations, and discussions among parties whether oral or written, with respect to the subject matter of the OT" (Bolos, 1997, p. 30).

Revision to the OT may only be accomplished through written consent of the CMC and the DARPA Contracting Officer. (Bolos, 1997, p. 30)

13. Attachment 1: Statement of Work

"This attachment provides a detailed explanation of what the consortium is expected to do under the research project. Normally it is written in terms of the problem to be solved, the technical approach, or the specific tasks to be accomplished" (Bolos, 1997, p. 31).

14. Attachment 2: Reporting Requirements

> "This article provides for quarterly reports, an annual program plan, special technical reports, payable milestone reports, and a final report. The quarterly report has a technical and a business section. The business section provides for summarized details of the resource status from both the government participation and the consortium's cost share" (Bolos, 1997, p. 31).

15. Attachment 3: Schedule of Payments and Payable Milestones

This attachment identifies task numbers and the month the task is scheduled to be completed, the payable milestones, DARPA payments due, and the consortium payments due. (Bolos, 1997. P. 32)

16. Attachment 4: Funding Schedule

"This provides for a schedule of projected DARPA program funding commitments by fiscal year and related consortium contributors by consortium member" (Bolos, 1997, p. 32).

17. Attachment 5: List of Government and Consortium Representatives

This attachment is a listing of names, addresses, phone numbers, and E-mail addresses of respective representatives from the government and industry teams. (Bolos, 1997, p. 32)

APPENDIX B. OT BETWEEN DARPA AND HDSS

TECHNOLOGY DEVELOPMENT

AGREEMENT

Between

HOLOGRAPHIC DATA STORAGE SYSTEMS TEAM
c/o the National Storage Industry Consortium
9888 Carroll Center Road, Suite 115
San Diego, CA 2126-4580

AND

THE ADVANCED RESEARCH PROJECTS AGENCY
3701 North Fairfax Drive
Arlington, Virginia 22203-1714

Concerning

RESEARCH INTO HOLOGRAPHIC DATA STORAGE SYSTEMS

Agreement No: MDA972-95-3-0004
ARPA Order No: B119/.4/.5
Total Amount of the Agreement: $32,168,997
Total Estimated Government Funding of the Agreement: $16,084,498
Funds Obligated: $1,621,617
Authority: 10 U.S.C. 2358 and 2371

Line of Appropriation:

AA 9740400.1320 B119 P4D10 2525 503733 DPAC 4 5259 - $741,000
AA 9740400.1320 B119 P4D10 2525 503733 DPAC 4 5259 - $880,617

This Agreement is entered into between The United States of America, hereinafter called the Government, represented by The Advanced Research Projects Agency (ARPA), and the Holographic Data Storage Systems Team (hereinafter referred to as the HDSS Team), and each member of the HDSS Team is a member in good standing of NSIC and is hereinafter referred to as a "Participant"), c/o the National Storage Industry Consortium (NSIC) pursuant to and under U. S. Federal law.

FOR THE HOLOGRAPHIC DATA STORAGE SYSTEMS TEAM		FOR THE ADVANCED RESEARCH PROJECTS AGENCY	
(Signature)	(Date)	(Signature)	(Date)
(Signature)	(Date)	(Signature)	(Date)

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ARTICLE I: SCOPE OF THE AGREEMENT

A. Background

The Holographic Data Storage Systems (HDSS) Team shall perform a coordinated technology research and development project (Project). This Project is based on an HDSS proposal submitted in response to ARPA's Broad Agency Announcement (BAA) 93-97 that addresses the development of holographic data storage systems through the establishment of the enabling technologies, their subsequent integration into operational testbeds, and an evaluation of performance. Though concepts of holographic data storage originated in the early 1960's, this technology has yet to reach the commercial or military market for several reasons. First, until recently the demand for high-capacity, high-bandwidth storage systems has not been well-defined. Second, the enabling technologies needed for information transfer to and from the storage medium were of inadequate performance and, finally, a suitable holographic recording material has not yet been identified. This last requirement for a recording material is addressed in a separate 30-month NSIC program called PRISM established in a separate agreement with ARPA under Advanced Material Synthesis and Processing.

Data rate is of critical importance in rapidly growing application for image storage, recovery, and processing. The goal of the proposed project is to exploit the information capacity of an optical wavefront by multiplexing data in parallel as a means to extend data rates far beyond the expected limits of conventional storage. Data storage capacities, enhanced by the ability to store multiple pages of information in a common volume, provide a means for rapid, nonmechanical access to large blocks of data. For military applications holographic data storage systems offer the possibility of storing large quantities of battlefield, reconnaissance, and tactical information which can be retrieved at rates far exceeding current capabilities. This should lead to improved dissemination of military information as well as to improvements in the quality of intelligence and target data.

The development of high-capacity, high-bandwidth holographic storage systems requires the specification, development and integration of several diverse technologies including: laser sources, spatial light modulators as data input devices, detector arrays for data output and optical beam steering systems for rapid access. While the base technologies are emerging for many of the needed photonic components, they are appearing in products developed for other application and often have performance specifications that do not match the needs of a holographic storage system. Customization is required to elevate performance levels and to minimize unfavorable trade-offs. The HDSS Team proposes to adapt the base component technologies to meet the specific needs of holographic storage systems by using a highly coordinated approach of coupled development programs to fabricate and test prototype devices and integrate them into working storage testbeds. The HDSS Team considers it of critical importance to focus this effort on the ultimate goal of transferring this technology to a successful

production environment. It is the intention of the HDSS Team to further develop this technology for commercial and military applications either in a joint effort with the Government of using private industry funds. It is expected that the cost of holographic data storage systems will be competitive with conventional storage technologies, but with the advantage of much higher data transfer rates and all solid state performance.

This project is being organized and will be administratively managed by the National Storage Industry Consortium (NSIC). NSIC's 40 industrial member companies and over 42 member universities have joined to conduct joint research to enhance the competitiveness of the United States digital recording industry in worldwide markets. NSIC's leadership ensures that commercialization of the technologies developed under this Agreement will be optimally facilitated. NSIC's involvement in other current projects , particularly PRISM, will provide additional technical leverage for the HDSS Project results, leading to enhanced commercial systems performance. NSIC regards this Project as a key part of its long-term technical strategy for this industry.

In the past, efforts to develop holographic storage systems have taken place independently in academic and industrial laboratories and often resulted in designs that would feature a specific strength or need of the organization. Because an individual organization did not have the resources or technical breadth to develop all the enabling technologies, the systems often used off-the-shelf components resulting in a compromise in performance and cost effectiveness. The uniqueness of the HDSS Team's proposal lies in its ability to address, in an integrated fashion, materials, components and systems with a partnership of members with expertise in each of the required areas. In addition the HDSS Team has the opportunity to leverage the materials research effort performed in the PRISM program and has established continuity with that program by the inclusion of some common participants. The participants in this proposal, chosen for the unique contributions they bring to the overall efforts, include large industrial complexes (IBM, GTE, Kodak, Rockwell), manufacturers of advanced photonic components (SDL, Inc., Kodak, Rochester Photonics), major universities (Stanford, U of Arizona, CMU and U of Dayton/TI) and a start-up company (Optitek).

The systems development efforts of this consortium will be guided by the general constraints of the ARPA BAA and also by the particular system requirements of three key application areas: computer storage, telecommunications and avionics systems. Key contributors in the consortium currently hold leading roles in these important markets and bring not only the required technologies for the effort but also the particular system applications expertise. IBM, GTE/Optitek and Rockwell will in respective order lead the effort in addressing the particular issues involving the computer, telecommunications and avionics applications.

B. Definitions

1. The following words shall have the meanings set forth below:

a) Agreement: This Consortium Agreement between the Holographic Data Storage systems (HDSS) Team and ARPA, including all attachments and any amendments thereof.

b) ARPA Agreements Administrator: The ARPA representative for administrative and contractual matters identified in Article IV>

c) ARPA Program Manager: The ARPA representative for technical matters identified in Article IV.

d) Collaboration Agreement: The Collaboration Agreement among the Participants (as defined below):

e) The Holographic Data Storage Systems (HDSS) Team: The parties identified in Attachment 5.

f) HDSS Team Agreements Administrator: Identified in Article IV.

g) HDSS Team Program Manager: Identified in Article IV.

h) Cost Sharing: Contributions made by Participants for the HDSS Team, including matching funds and in-kind contributions.

i) Participants: Individual members of the Consortium identified in Attachment 5.

j) Parties: The parties to this Agreement, including the individual members of the HDSS Team.

k) Payable Event of Payable Milestone: Defined in Attachment 3.

l) Project: The Research into Holographic Data Storage systems, as more specifically described in Attachment 1.

m) Term: Defined in Article II.

C. Scope

1. The HDSS Team shall perform a coordinated research and development project (Project) designed to develop holographic data storage systems. The research shall be carried out in accordance with the Statement of Work incorporated in this Agreement as Attachment 1. The Consortium shall submit or otherwise provide all documentation required by Attachment 2, Report Requirements.

2. The HDSS Team shall be paid for each Payable Event accomplished in accordance with the Schedule of Payments and Payable Events set forth in Attachment 3 and the procedures of Article V. Both the Schedule of Payments and the Funding Summary set forth in Attachments 3 and 4 respectively may be revised or updated in accordance with Article III.

3. The Government and the HDSS Team estimate that the Statement of Work of this Agreement can only be accomplished with the Consortium aggregate resource contribution of $16,084,499. The HDSS Team intends and, by entering into this Agreement, undertake to cause to be provided these funds. HDSS Team contributions will be provided as detailed in the Funding Summary set forth in Attachment 4. If either ARPA or the HDSS Team is unable to provide its respective total contribution, the other party may reduce its project funding by a proportionate amount.

D. Goals/Objectives

1. The goals of this Agreement are as follows:

a) The demonstration of a high-capacity (up to 1024x1024), high-bandwidth (up to 1000 fps) spacial light modulator for use as a data input device;

b) The demonstration of an optimized 1024x1024CCD sensor arrays and associated circuitries to permit high frame transfer rates (at least 1000 fps);

c) The demonstration of a manufacturable high-power visible (red) laser diode source;

d) A report describing a significantly improved understanding of the systems trade-offs of various multiplexing schemes in relation to candidate materials;

e) The demonstration of a 2-D data coding, error detection and correction scheme;

f) Proof-of-principle demonstration holographic data storage devices (available 18 months into the program) to establish the storage capability of various multiplexing methods and to understand trade-offs between complexity, cost and manufacturability;

g) Holographic storage testbeds for evaluation of functional performance. Four testbeds are envisioned to achieve goals; (1) two WORM testbeds and (2) two erasable testbeds. The WORM systems will be operational at the end of the third year and the erasable testbeds operational before the end of the fifth year. These testbeds will not be commercial products. They are intended, however, to provide the bases for subsequent product development.

2. The Government will have continuous involvement with the Participants who comprise the HDSS Team. The Government will be an active participant on the Technical Representatives Committee. The Government will also obtain access to research results and certain rights in data and patents as described in Articles VII and VIII. ARPA and the HDSS Team are bound to each other by a duty of good faith and best research effort in achieving the goals of the Project. This Agreement reflects the collaborative document identified as "Project Agreement by and among Participants of the HDSS Project", which document binds Consortium participants.

3. This Agreement is an "other transaction" pursuant to 10 U.S.C. 2371. The Parties agree that the principal purpose of this Agreement is for the Government to support and stimulate the HDSS Team to provide its best efforts in advanced research and technology development and not for the acquisition of property or services for the direct benefit or use of the Government. The Federal Acquisition Regulation (FAR) and Department of Defense FAR Supplement (DFARS) apply only to the extent specifically referenced herein. This Agreement is not a procurement contract or grant agreement for purposes of FAR subpart 31.20518. This Agreement is not intended to be, nor shall it be construed as, by implication or otherwise, a partnership, a corporation, or other business organization.

ARTICLE II: TERM

A. The Term of this Agreement

The HDSS Project commences upon the date of the last signature hereon and continues for 60 months. If all funds are expended prior to the 60 month duration, the Parties have no obligation to continue performance and may elect to cease Project efforts at that point. Provisions of this Agreement, which by their express terms apply for periods of time other than specified herein, shall be given effect, notwithstanding this Article.

B. Termination Provisions

Subject to a reasonable determination that the program will not produce beneficial results commensurate with the expenditure of resources, either Party may terminate this Agreement by written notice to the other Party, provided that such written notice is preceded by consultation between the Parties. In the event of a termination of the

Agreement, the Government shall have paid-up Government purpose license rights to CATEGORY C data (as defined in Article Viii of this Agreement) developed under this Agreement. The Government and the HDSS Team, acting through its HDSS Board, will negotiate in good faith a reasonable and timely adjustment of all outstanding issues between the Parties as a result of termination. Failure of the Parties to agree to a reasonable adjustment will be resolved pursuant to Article VI, disputes. The Government has no obligation to reimburse the Consortium beyond the last completed and paid milestone if the Consortium, acting through its Consortium Management Committee, decides to terminate.

C. Extending the Term

The Participants may extend by mutual agreement the terms of this Agreement if funding availability and research opportunities warrant. Any extension shall be formalized through modification of the Agreement by the ARPA Agreements Administrator and the HDSS Team Agreements Administrator.

ARTICLE III: MANAGEMENT STRUCTURE

A. Management and Project Structure

1. Technical and Project management of the coordinated research Project established under this Agreement shall be accomplished through the management structures and processes detailed in this Article.

a) The HDSS Board shall consist of one representative from ARPA, one representative from NSIC, and one member from each of the Participants on the HDSS Team and shall be responsible for the overall management of the HDSS Team including technical and Project administrative matters. The HDSS Board shall select a Director of Operations from among its members to act on behalf of the HDSS Team. The HDSS Board will be assisted in executing its responsibilities by the Technical Representatives Committee.

b) The Technical Representatives Committee of the HDSS Team shall be comprised of one member from each of the Participant's organizations and shall make recommendations to the HDSS Board as to Project goals, strategy to achieve Project goals, technical review of solicited Participants Project plans and funding as related to progress towards goals. A Government technical representative from ARPA shall be a member of the Technical Representatives Committee. The HDSS Board may also allow other Government personnel from non-contributing agencies to participate.

c) Project Plans, as described below in Article III, Section B, shall be submitted to the ARPA Project Manager.

B. Project Management Planning Process

The Project plan will consist of inputs and review from the HDSS Team and ARPA management, containing the detailed schedule of research activities and Payable Events.

1. Initial Project Plan

The HDSS Team will follow the Project Plan that is contained in the Statement of Work (Attachment 1).

2. Overall Project Plan Review

a) The HDSS Team, with ARPA Program Manager participation and review, will prepare an overall macro-level Project Plan in the second calendar quarter (third government fiscal quarter) of each year. The Project Plan will be presented and reviewed at an annual site review which will be attended by the appropriate, and other ARPA Project managers and personnel as appropriate. ARPA and the HDSS Team will prepare a final Project Plan. The Project Plan is subject to the approval of the ARPA Project Manager.

b) The Project Plan provides a detailed schedule of research activities, commits the HDSS Team to meet specific performance objectives, includes forecast expenditures and describes the Payable Events. In the event that a Payable Events is not substantially achieved, the HDSS Team will supply the ARPA Program Manager with a "corrective action plan" in writing within 15 days following the end of a missed Payable Event. The HDSS Team will document the accomplishment of all Payable Events in accordance with Attachment 2, Paragraph D.

C. Modifications

1. As a result of quarterly meetings, annual reviews, or at any time during the term of the Agreement, research progress or results may indicate that a change in the Statement of Work and/or the Payable Milestones, would be beneficial to program objectives. Recommendations for modifications, including justifications to support any changes to the Statement of Work and/or Payable Milestones, will be documented in a letter and submitted by the HDSS Board to the ARPA Program Manager with a copy to the ARPA agreements Administrator. This documentation letter will detail the technical, chronological, and financial impact of the proposed modification to the research program. The HDSS Board shall approve any Agreement modification. The Government is not obligated to pay for additional or revised Payable Milestones until the Payable Milestones Schedule (Attachment 3) is revised by the ARPA Agreements Administrator and made part of this Agreement.

2. For any additional or revised Payable Event that is recommended in the Project Plan, the HDSS Team shall supply appropriate written documentation as directed by the ARPA Project Manager, which describes the effort, provides for Payable Events and provides Payable Events forecasts. The Government is not obligated to pay for additional or revised Payable Events until the Payable Events Schedule (Attachment 3) is revised and made part of this Agreement.

3. The Payable Events Schedule may not be changed except with the written approval of ARPA's Agreement Administrator.

ARTICLE IV: AGREEMENT ADMINISTRATION

1. Administrative and contractual matters under this Agreement shall be referred to the following representatives of the Parties:

ARPA: [named representatives]

HDSS: [named representatives]

2. Technical matters under this Agreement shall be referred to the following representatives of the Parties:

ARPA: [named representatives]

HDSS: [named representatives]

The Parties may change the individuals named in this Article by written notification to the other Parties.

ARTICLE V: OBLIGATION AND PAYMENTS

A. Obligation

1. The Government's obligation to make payments to the HDSS Team is limited to only those funds obligated by this Agreement or by amendment to this Agreement. ARPA may incrementally fund this Agreement.

2. If modification becomes necessary in the performance of this Agreement, pursuant to Article III, paragraph B, the ARPA Agreement Administrator shall execute a revised Payable Events schedule consistent with the then current Project Plan.

B. Payments

1. In addition to any other financial reports provided or required, the HDSS Board shall notify the ARPA Agreement Administrator immediately if any contribution from any HDSS Team Participant is not made as required.

2. The HDSS Team's financial matters shall be handled by NSIC through an internal accounting system, separate from all other NSIC accounts, which complies with Generally Accepted Accounting Principles and with the requirements of this Agreement. NSIC is authorized by the Participants to receive and disburse funds on behalf of the HDSS Team and shall ensure that appropriate arrangements have been made for receiving, distributing and accounting for Federal Funds. The Parties recognize that as a conduit, the HDSS Team does not incur nor does it allocate any indirect costs of its own to the HDSS Team member cost directly incurred pursuant to this Agreement. Consistent with this, an acceptable accounting system will be one where all cash receipts and disbursements are controlled and documented properly.

3. The HDSS Team shall document the successful accomplishment of each Payable Event by submitting or otherwise providing the Payable Events Report required by Attachment 2, Part D. The HDSS Team will submit an original and five copies of all invoices to the ARPA Agreements Administrator for approval. After written verification of the successful completion of the Payable Event by the ARPA Program Manager, and approval by the ARPA Agreements Administrator, the invoices will be forwarded to the payment office within thirty (30) calendar days of receipt of the invoices by ARPA. Payments will be made by AFDW/APO/AFMCSD, Attn: Commercial Services, 170 Luke Avenue, Suite 280, Bolling Air Force Base, Washington, DC 20332-5260 within ten (10) days of ARPA's transmittal. Payment shall be made to NSIC at the address provided on the cover of this Agreement.

4. Payments shall be made no more frequently than quarterly in the amounts set forth in the Attachment 3 "Detailed Schedule of Payable Events", provided the ARPA Program Manager has verified the accomplishment of the Payable Events. It is recognized that the quarterly accounting of current expenditures reported in the "Quarterly Business Status Report" submitted in accordance with Attachment 2 is not necessarily intended or required to match the Payable Events until submission of the Final Report; however, Payable Events shall be revised during the course of the Project to reflect current and revised projected expenditures.

5. Limitation of Funds: In no case shall the Government's financial liability exceed the amount obligated under this Agreement as set forth in Attachment 4.

6. Financial Records and Reports: The HDSS Team shall maintain adequate records to account for Federal funds received under this Agreement; and shall maintain adequate records to account for HDSS Team Participant funding provided under this Agreement.

Upon completion or termination of this Agreement, whichever occurs earlier, the HDSS Administrator shall furnish to the Agreement Administrator a copy of the financial report required by Attachment 2, Part E. the HDSS Team's relevant financial records are subject to examination or audit on behalf of ARPA by the Government for a period not to exceed three (3) years after expiration of the term or earlier termination of this Agreement. The Agreement Administrator or designee shall have direct access to sufficient records and information of the HDSS Team, to ensure full accountability for all funding under this Agreement. Such audit, examination, or access shall be performed during business hours on business days upon prior written notice and shall be subject to the security requirements of the audited Party.

ARTICLE VI: DISPUTES AND LIMITATION OF DAMAGES

A. General

The Parties shall communicate with one another in good faith and in a timely and cooperative manner when raising issues under this Article.

B. Dispute Resolution Procedures

1. Any disagreement, claim or dispute between ARPA and the HDSS Team concerning questions of fact or law arising from or in connection with this Agreement, and, whether or not involving an alleged breach of this Agreement, may be raised only under this Article.

2. Whenever disputes, disagreements, or misunderstandings arise, the Parties shall attempt to resolve the issue(s) involved by discussion and mutual agreement as soon as practicable. No dispute, disagreement or misunderstanding, which arose more than three (3) months prior to the notification made under subparagraph B.3 of this article, will constitute the basis for relief under this Article unless the Director of ARPA in the interests of justice waives this requirement.

3. Failing resolution by mutual agreement within three months, the aggrieved Party shall document the dispute, disagreement or misunderstanding by notifying the other Party (through ARPA Agreements Administrator of HDSS Administrator, as the base may be) in writing of the relevant facts, identify unresolved issues, and specify the clarification or remedy sought. Within five (5) working days after providing notice to the other Party, the aggrieved Party may, in writing, request a joint decision by the ARPA Deputy Director for Management and Representative of the HDSS Board. The other Party shall submit a written position on the matter(s) in dispute within thirty (30) calendar days after being notified that a decision has been requested. The ARPA Deputy Director for Management and the HDSS Team Representative shall conduct a review of the matter(s) in dispute and render a decision in writing within thirty (30) calendar days of receipt of such written position. Any such joint decision is final and binding unless a

Party shall within thirty (30) calendar days request further review as provided in this Article.

4. Upon written requests to the Director of ARPA, made within thirty (30) calendar days or upon unavailability of a joint decision under subparagraph B.3 above, the dispute shall be further reviewed. The Director of ARPA may elect to conduct this review personally or through a designee or jointly with a representative of the Consortium who is a senior official of a Participant. Following the review, the Director of ARPA or designee will resolve the issue(s) and notify the Parties in writing. Such resolution is not subject to further administrative review and, to the extent permitted by law, shall be final and binding.

5. Subject only to this article and 41 U.S.S. 321-322, if not satisfied with the results of completing the above process, either Party may within thirty (30) calendar days of receipt of the notice in subparagraph B.4 above pursue any right and remedy in a court of competent jurisdiction.

C. Limitation of Damages

Claims for damages of any nature whatsoever pursued under this Agreement shall be limited to direct damages only up to the aggregate amount of ARPA funding disbursed as of the time the dispute arises. In no event shall ARPA be liable for claims for consequential, punitive, special and incidental damages, claims for lost profits, or other indirect damages. ARPA agrees that there is no joint and several liability within the HDSS Team. The HDSS Team Participants disclaim any liability for consequential, indirect, or special damages, except when such damages are caused by willful misconduct of the HDSS Team Participant personnel. In no event shall the liability of a HDSS Team Participant or any other entity performing research activities under this Agreement exceed the funding it has received up to the time of incurring such liability. Similarly, the administrative organization, NSIC, shall not be liable for the acts or omissions of the other HDSS Team Participants, but shall be liable for its own work to the extent supported by ARPA funding.

ARTICLE VII: PATENT RIGHTS

A. Definitions

1. "Invention" means any invention or discovery which is or may be patentable or otherwise protectable under Title 35 of the United States Code.

2. "Made" when used in relation to any invention means the conception of first actual reduction to practice of such invention.

3. "Practical application" means to manufacture, in the case of a composition or product; to practice, in the case of a process or method; or to operate, in the case of a machine or system; and, in each case, under such conditions as to establish that the invention is capable of being utilized and that its benefits are, the extent permitted by law or Government regulations, available to the public on reasonable terms.

4. "Subject Invention" means any invention by a HDSS Team Participant, conceived or first actually reduced to practice in the performance of work under this Agreement.

B. Allocation of Principal Rights

Unless the HDSS Team shall have notified ARPA, (in accordance with subparagraph C.2 below) that the HDSS Team does not intend to retain title, the HDSS Team shall retain the entire right, title, and interest throughout the world to each Subject Invention consistent with the provision of the Project Agreement by and among Participants of the HDSS Project, this Article, and 35 U.S.C. 202. With respect to any Subject Invention in which the HDSS Team retains title, ARPA shall have a non-exclusive, nontransferable, irrevocable, paid-up license to practice or have practiced on behalf of the Untied States the Subject Invention through the world.

C. Invention disclosure, election of title, and filing of patent application

1. The HDSS Team shall disclose each Subject Invention to ARPA within four (4) months after the inventor discloses it in writing to his company personnel responsible for patent matters. The disclosure to ARPA shall be in the form of a written report and shall identify the Agreement under which the Invention was made and the identity of the inventor(s). It shall be sufficiently complete in technical details to convey a clear understanding to the extent known at the time of the disclosure, of the nature, purpose, operation, and the physical, chemical, biological, or electrical characteristics of the Invention. The disclosure shall also identify any publication, sale, or public use of the Invention and whether a manuscript describing the Invention has been submitted for publication and, if so, whether it has been accepted for publication at the time of disclosure.

2. If a HDSS Team Participant determines that it does not intend to retain title to any such invention, the HDSS Team Participant shall notify ARPA, in writing, within eight (8) months of disclosure to ARPA. However, in any case where publication, sale, or public use has initiated the one (1) year statutory period wherein valid patent protection can still be obtained in the United States, the period for such notice may be shortened by ARPA to a date that is no more than sixty (60) calendar days prior to the end of the statutory period.

3. The HDSS Team Participant shall file its initial patent application on a Subject Invention to which it elects to retain title within one (1) year after election of title, but

prior to the end of the statutory period wherein valid patent protection can be obtained in the United States after a publication, or sale, or public use. The HDSS Team Participant may elect to file patent applications in additional countries (including the European Patent Office and under the Patent Cooperation Treaty) within either twelve (12) months of the corresponding initial patent application or six (6) months from the date permission is granted by the Commissioner of Patents and Trademarks to file foreign patent applications, where such filing has been prohibited by a Secrecy Order.

4. Requests for extension of the time for disclosure election, and filing under Article VII, paragraph C, may, at the discretion of ARPA, and after considering the position of the HDSS Team Participant be granted.

D. Conditions When the Government May Obtain Title

Upon ARPA's written request, the HDSS Team shall convey title to any Subject Invention to ARPA under any of the following conditions:

1. If the HDSS Team Participant fails to disclose or elects not to retain title to the Subject Invention within the times specified in paragraph C of this Article; provided that ARPA may only request title within sixty (60) calendar days after learning of the failure of the HDSS Team to disclosure or elect within the specified times.

2. In those countries in which the HDSS Team Participant fails to file patent applications within the times specified in paragraph C of this Article; provided, that if the HDSS Team Participant has filed a patent application in a country after the times specified in paragraph C of this Article, but prior to its receipt of the written request by ARPA, the HDSS Team Participant shall continue to retain title in that country; or

3. In any country in which the HDSS Team Participant decides not to continue the prosecution of any application for, to pay the maintenance fees on, or defend in reexamination or opposition proceedings on, a patent on a Subject Invention.

E. Minimum Rights to the HDSS Team and Protection of the HDSS Team's Right to File

1. The HDSS Team Participant shall retain a non-exclusive, royalty-free license throughout the world in each Subject Invention to which the Government obtains title, except if the HDSS Team Participant fails to disclose the Subject Invention within the times specified in paragraph C of this Article. The HDSS Team Participant's license extends to the domestic (including Canada) subsidiaries and affiliates, if any, of the HDSS Team Participants within the corporate structure of which the HDSS Team Participant is a party and includes the right to grant licenses of the same scope to the extent that the HDSS Team Participant was legally obligated to do so at the time the Agreement was awarded. The license is transferable only with the approval of ARPA,

except when transferred to the successor of that part of the business to which the Subject Invention pertains. ARPA approval for license transfer shall not be unreasonably withheld.

2. The HDSS Team Participant's domestic license may be revoked or modified by ARPA to the extent necessary to achieve expeditious practical application of the subject invention pursuant to an application for an exclusive license submitted consistent with appropriate provisions at 37 CFR Part 404, provided that such revocation or modification shall not take place less than three (3) years after the end of the term of the Agreement. This license shall not be revoked in that field of use or the geographical areas in which the HDSS Team Participant has achieved practical application and continues to make the benefits of the invention reasonably accessible to the public. The license in any foreign country may be revoked or modified at the discretion of ARPA to the extent the HDSS Team Participant, its licensees, or the subsidiaries or affiliates have failed to achieve practical application in that foreign country.

3. Before revocation or modification of the license, ARPA shall furnish the HDSS Team Participant a written notice of its intention to revoke or modify the license, and the HDSS Team Participant shall be allowed thirty (30) calendar days (or such other time as may be authorized for good cause shown) after the notice to show cause why the license should not be revoked or modified.

F. Action to Protect the Government's Interest

1. The HDSS Team agrees to execute or to have executed and promptly delivered to ARPA all instruments necessary to (i), establish the rights the Government has throughout the world in those Subject Inventions to which the HDSS Team Participant elects to retain title, and (ii), convey title to ARPA when requested under paragraph D of this Article and to enable the Government to obtain patent protection throughout the world in that Subject Invention.

2. The HDSS Team agrees to require, by written agreement, that employees of the Participants of the HDSS Team working on the HDSS Team, other than clerical and nontechnical employees, agree to disclose promptly in writing, to personnel identified as responsible for the administration of patent matters and in a forma acceptable to the HDSS Team, each Subject Invention made under this Agreement in order that the HDSS Team can comply with the disclosure provisions of paragraph C of this Article. The HDSS Team Participants shall instruct their employees, through employee agreements or other suitable educational programs, on the importance of reporting inventions in sufficient time to permit the filing of patent applications prior to U. S. or foreign statutory bars.

3. The HDSS Team Participants shall notify ARPA of any decisions not to continue the prosecution of a patent application, pay maintenance fees, or defend in a

reexamination or opposition proceedings on a patent, in any country, not less than thirty (30) calendar days before the expiration of the response period required by the relevant patent office.

4. The HDSS Team Participants shall include, within the specification of any United States patent application and any patent issuing thereon covering a Subject Invention, the following statement: "This invention was made with Government support under Agreement No. MDA972-95-3-004, awarded by ARPA. The Government has certain rights in the invention."

G. Lower Tier Agreements

1. The HDSS Team Participants shall include this Article, suitably modified to identify the Parties, in all lower tier agreements, regardless of tier, for experimental, developmental, or research work.

2. In the case of a lower tier agreement with a vendor, at any tier, ARPA, the vendor, and the HDSS Team agree that the mutual obligations of the parties created by this Article flow down to the vendor and constitute an agreement between the vendor and ARPA with respect to the matters covered by this Article.

H. Reporting on Utilization of Subject Inventions

The HDSS Team agrees to submit, during the term of the Agreement, periodic reports no more frequently than annually on the utilization of a Subject Invention or on efforts at obtaining such utilization of a Subject Invention that are being made by the HDSS Team or licensees or assignees of the inventor. Such reports shall include information regarding the status of development, date of first commercial sale or use, if any, and such other data and information as ARPA may reasonably specify. The HDSS Team also agrees to provide additional reports as may be requested by ARPA in connection with any march-in proceedings undertaken by ARPA in accordance with paragraph J of this Article. consistent with 35 U.S.C. 202(c)(5), ARPA agrees it shall not disclose such information to persons outside the Government without permission of the HDSS Team.

I. Preference for American Industry

Notwithstanding any other provisions of this clause, the HDSS Team agrees that it shall not grant to any person the exclusive right to use or sell any Subject Invention in the United States or Canada unless such person agrees that any product embodying the Subject Invention or produced through the use of the Subject Invention shall be manufactured substantially in the United States or Canada. However, in individual cases, the requirements for such an agreement may be waived by ARPA upon a showing by the HDSS Team that reasonable but unsuccessful efforts have been made to grant licenses on similar terms to potential licensees that would be likely to manufacture substantially in

the United States or that, under the circumstances, domestic manufacture is not commercially feasible.

J. March-in Rights

The HDSS Team agrees that, with respect to any subject invention in which it has retained title, ARPA has the right to require the HDSS Team, an assignee, or exclusive licensee of a subject invention to grant a non-exclusive license to a responsible applicant or applicants, upon terms that a reasonable under the circumstances, and if the HDSS Team, assignee, or exclusive licensee refuses such a request, ARPA has the right to grant such a license itself if ARPA determines that:

1. Such action is necessary because the HDSS Team or assignee has not taken within a reasonable time, effective steps to achieve practical application of the Subject Invention, a reasonable time being no less than five (5) years from the end of the term of the Agreement.

2. Such action is necessary to alleviate health or safety needs which are not reasonably satisfied by the HDSS Team , assignee, or their licensees;

3. Such action is necessary to meet requirements for public use and such requirements are not reasonably satisfied by the HDSS Team, assignee, or licensees; or

4. Such action is necessary because the agreement required by paragraph (I) of this Article has not been obtained or waived or because a licensee of the exclusive right to use or sell any Subject Invention in the United States is in breach of such Agreement.

ARTICLE VIII: DATA RIGHTS

A. Additional Definitions

1. "Government Purpose License Rights" (GPLR), as used in this article, means rights to use, duplicate, or disclose data, in whole or in part and in any manner, for Government purposes only, and to have or permit others to do so for Government purposes only. Government purposes include competitive procurement, but do not include the right to have or permit others to use technical data for commercial purposes.

2. "Unlimited Rights", as used in this article, means rights to use, duplicate, release, or disclose, technical data or computer software in whole or in part, in any manner and for any purposes whatsoever, and to have or permit others to do so.

3. "Data", as used in this article, means recorded information , regardless of form or method of recording, which includes but is not limited to intellectual property, technical data, software, trade secretes, and mask works. The term does not include financial,

administrative, cost, pricing or management information and does not include Subject Inventions included under Article VII.

4. "Technical Data", as used in this article, means recorded information, regardless of the form or method of the recording of a scientific or technical nature (including computer software documentation). The term does not include computer software or data incidental to agreement administration, such as financial and/or management information.

B. Data Categories

The Parties agree to the following categories of Data.

1. Category A is the HDSS Team Data developed and paid for totally by private funds and is Data to which the HDSS Team retains all rights.

2. Category B is the HDSS Team developed and Government funded Data which cannot be disclosed without compromising the HDSS Team Category A Data.

3. Category C is the HDSS Team developed Data, excluding Category A and B Data.

C. Allocation of Principal Rights

1. This Agreement shall be performed with mixed Government and HDSS Team funding. The Parties agree that in consideration for ARPA's funding, and in lieu of any Government rights to Categories A or B (except as contained in subparagraph C.4 below) Data, the HDSS Team intends to reduce to practical application materials and processes developed under this Agreement.

2. No deliveries in Category A and B are contemplated or required under this Agreement; therefore, no rights in Category A and B Data shall be granted to ARPA. There are no Category A or B Data identified at the time of execution of the Agreement.

3. In the event the HDSS Team does not reduce to practical application items components and processes developed under this Agreement within five (5) years after conclusion of this Agreement, ARPA shall have Government Purpose License Rights to Category B Data for a period of five (5) years after conclusion of the Agreement, after which five (5) year period, the Government shall have Unlimited Rights to Category B Data.

4. ARPA shall have Government Purpose License Rights to Category C Data for a period of five (5) years after conclusion of the Agreement, after which five (5) year period, the Government shall have Unlimited Rights to Category C Data.

5. The HDSS Team will prepare a list of Category A and B data for incorporation into this Agreement for the first year within a reasonable period following the award of this Agreement and subsequent years, as part of the annual planning process described in Article III. Following mutual agreement of the Parties on the list of Category A and B data, the ARPA Agreements Administrator will incorporate this list of written modifications.

D. Marking of Data

Any Data delivered under this Agreement shall be marked with the following legend:

Use, duplication, or disclosure is subject to the restrictions as stated in Agreement MDA972-95-3-0004 between the Advanced Research Projects Agency and the HDSS Team.

E. Lower Tier Agreements

The HDSS Team shall include this Article, suitably modified to identify the Parties, in all lower tier agreements, regardless of tier, for experimental, developmental, or research work.

ARTICLE IX: FOREIGN ACCESS TO TECHNOLOGY

This Article shall remain in effect during the term of the Agreement and for five (5) years thereafter.

A. Definition

"Foreign Firm or Institution" means a firm or institution organized or existing under the laws of a country other than the United States, its territories, or possessions. The term includes, for purposes of this Agreement, any agency or instrumentality of a foreign government; and firms, institutions or business organizations which are owned or substantially controlled by foreign governments, firms, institutions, or individuals.

"Know-How" means all information including, but not limited to discoveries, formulas, materials, inventions, processes, ideas, approaches, concepts, techniques, methods, software, Projects, documentation, procedures, firmware, hardware, technical data, specifications, devices, apparatus and machines.

"Technology" means patentable and unpatentable discoveries, innovations, Know-How, inventions and computer software that are recognized under U.S. law as intellectual creations to which rights of ownership accrue, including, but not limited to, patents, trade secrets, mask works and copyrights developed under this Agreement.

B. General

The Parties agree that research findings and technology developments in Holographic Data Storage Systems technology may constitute a significant enhancement to the national defense, and to the economic vitality of the United States. Accordingly, access to important technology developments under this Agreement by Foreign Firms or Institutions must be carefully controlled. The controls contemplated in this Article are in addition to, and are not intended to change or supersede, the provisions of the International Traffic in Arms Regulation (22 CFR pt. 121 et seq.), the DoD Industrial Security Regulation (DoD 5220.22-R) and the Department of Commerce Export Regulation (15 CFR pt. 770 et seq.)

C. Restrictions on Sale or Transfer of Technology to Foreign Firms or Institutions

1. In order to promote the national security interests of the United States and to effectuate the policies that underlie the regulations cited above, the procedures stated in subparagraphs C.2, C.3, and C.4 below shall apply to any transfer of Technology. For purposes of this paragraph, a transfer includes a sale of the company, and sales or licensing of Technology. Transfers do not include:

a) sales of products or components, or

b) licenses of software or documentation related to sales of products or components, or

c) transfer to foreign subsidiaries of the HDSS Team Participants for purposes related to this Agreement, or

d) transfer which provides access to Technology to a Foreign Firm or Institution which is an approved source of supply or source for the conduct of research under this Agreement provided that such transfer shall be limited to that necessary to allow the firm or institution to perform its approved role under this Agreement.

2. The HDSS Team shall provide timely notice to ARPA of any proposed transfers from the HDSS Team of Technology developed with ARPA funding under this Agreement to Foreign Firms or Institutions. If ARPA determines that the transfer may have adverse consequences to the national security interests of the United States, the HDSS Team, its vendors, and ARPA shall jointly endeavor to find alternatives to the proposed transfer which obviate or mitigate potential adverse consequences of the transfer but which provide substantial equivalent benefits to the HDSS Team.

3. In any event, the HDSS Team shall provide written notice to the ARPA Project Manager and ARPA Agreement Administrator of any proposed transfer to a Foreign Firm or Institution at least sixty (60) calendar days prior to the proposed date of transfer. Such

notice shall cite this Article and shall state specifically what is to be transferred and the general terms of the transfer. Within sixty (60) calendar days of receipt of the HDSS Team's written notification, the ARPA Agreement Administrator shall advise the HDSS Team whether it consents to the proposed transfer. In cases where ARPA does not concur or sixty (60) calendar days after receipt or ARPA provides no decision, the HDSS Team may utilize the procedures under Article VI, Disputes. No transfer shall take place until a decision is rendered.

4. Except as provided in subparagraph C.1 above and in the event the transfer of Technology to Foreign Firms or Institutions is approved by ARPA, the HDSS Team shall (a) refund to ARPA funds paid for the development of the Technology and (b) negotiate a license with the Government to the Technology under terms that are reasonable under the circumstances.

D. Lower Tier Agreements

The HDSS Team shall include this Article, suitably modified to identify the Parties, in all lower tier agreements, regardless or tier, for experimental, developmental, or research work.

ARTICLE X: OFFICIALS NOT TO BENEFIT

No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this Agreement, or to any benefit arising from it. However, this clause does not apply to this Agreement to the extent that this Agreement is made with a Corporation for the Corporation's general benefit.

ARTICLE XI: CIVIL RIGHTS ACT

This Agreement is subject to the compliance requirements of Title VI of the Civil Rights Act of 1964 as amended (42 U.S.C. 2000-d) relating to nondescrimination in Federally assisted programs. Each HDSS Team Participant's company has signed an Assurance of Compliance with the nondiscriminatory provisions of the Act. This Parties recognize that since the HDSS Team has no employees, that compliance is the responsibility of each Participant.

ARTICLE XII: ORDER OF PRECEDENCE

In the event of any inconsistency between the terms of this Agreement and language set forth in the Project Agreement by and among Participants of the HDSS Project, the inconsistency shall be resolved by giving precedence in the following order: (1) This Agreement, (2) Attachments to this Agreement, (3) Project Agreement by and among Participants of the HDSS Project.

ARTICLE XIII: EXECUTION

This Agreement constitutes the entire agreement of the Parties and supersedes all prior and contemporaneous agreements, understandings, negotiations and discussions among the Parties, whether oral or written, with respect to the subject matter hereof. This Agreement may be revised only by written consent of the HDSS Board and ARPA Agreement Administrator. This Agreement, or modifications thereto, may be executed in counterparts each of which shall be deemed as original, but all of which taken together shall constitute one and the same instrument.

ARTICLE XIV: DISCLAIMER

Such information as may be transmitted or exchanged by the Team Participants under this Agreement shall not constitute any representation, warranty, assurance, guarantee or inducement by any Party to the other Parties with respect to the infringement of any patent or proprietary right owned by or controlled by any third party and nothing in this Agreement shall be construed as a warranty or representation of any kind with respect to the content, accuracy, sufficiency, practicality, performance or adequacy of the information.

NO PARTY MAKES ANY WARRANTY OR REPRESENTATION, WHETHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE CONTENT OR ACCURACY OF DOCUMENTS AND INFORMATION EXCHANGED BY THE PARTIES AND THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. NO PARTY WILL BE LIABLE TO THE OTHER PARTY(IES) FOR INCIDENTAL, INDIRECT, SPECIAL OR PUNITIVE DAMAGES, LOST PROFITS OR ANY OTHER CONSEQUENTIAL DAMAGES, REGARDLESS OF THE FORM OF ACTION, EVEN IF SUCH PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE, RESULTING FROM BREACH OF ITS OBLIGATIONS HEREUNDER TO THE OTHER PARTY OR FROM THE TRANSFER OR USE OF INFORMATION SUPPLIED PURSUANT TO THIS AGREEMENT.

ARTICLE XV: FORCE MAJEURE

No Party shall be liable for the consequences of any unforeseealbe force majeure event that (1) is beyond its reasonable control, (2) is not caused by the fault or negligence of such Party, (3) causes such Party to be unable to perform its obligations under this Agreement and (4) cannot be overcome by the exercise of due diligence. In the event of the occurrence of a force majeure event, the Party unable to perform shall promptly notify the other Parties. It shall suspend performance only for such period of time as is necessary as a result of the force majeure and it shall further pursue its best efforts to resume as quickly as possible.

CERTIFICATIONS

The following certifications apply to Agreement number MDA972-95-3-0004

1. The undersigned certified, to the best of his or her knowledge and belief, that

a) Pursuant to the requirements of OMR Circular A-129, this organization certifies that is not delinquent on any Federal debt.

b) Pursuant to Executive Order 12549 and implementing rule, this organization certifies that it presently is not debarred, suspended, proposed for debarment, declared ineligible or voluntarily excluded from covered transactions by any Federal department or agency.

c) Pursuant to Public Las 100-690 and implementing final rule, effective 24 July 1990, this organization certifies that it will provide a drug-free workplace. The place of performance is:

988 Carroll Canyon Rd., Ste 115, San Diego, CA 92126-4580

[Street Address] [City, County, State] [Zip Code]

2. The following certification applies only to actions exceeding $100,000.00:

Section 1352, Title 31, U.S.C. (Public Law 101.121, Section 319) entitled, "Limitation on use of appropriated funds to influence certain Federal contracting and financial transactions."

1) No Federal appropriated funds have been paid or will be paid by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an Officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal Grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan or cooperative agreement.

2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the Federal contract, grant, loan or cooperative agreement, the undersigned shall complete and submit Standard Form LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

3) The undersigned shall required that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that al subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000.00 and not more than $100,000.00 for each such failure.

[Typed Name and Title of Official responsible for this transaction]	[Name of Organization/Institution
[Signature of Official responsible for this transaction]	[Date]

STATEMENT OF WORK

1.0 INTRODUCTION

The purpose of the Holographic Data Storage System (HDSS) Team is to address critical systems and components issues pertaining to holographic data storage systems. In the accompanying program, PRISM, partially funded by ARPA and the Participants, critical issues related to materials for HDSS are addressed. In the past, considerable basic research efforts have been carried out to understand and improve photorefractive materials and to develop photonic components needed for a variety of systems, such as charge coupled devices (DDC), spacial light modulators (SLM), and green and near-infrared compact lasers; but no HDSS systems demonstration has been carried out. It is the objective of the HDSS Team effort to develop and demonstrate four holographic data storage testbeds for evaluation of functional performance; (1) two WORM testbeds and (2) two erasable testbeds. The objectives of the HDSS Team can be accomplished through a coordinated and cooperative effort between a select group of Participants carefully selected for their experience in the fields of photorefractivite physics, component devices, holography, lasers, data storage, military avionics and telecommunications. The uniqueness of the proposed approach lies in the ability to address, in an integrated fashion, materials, components and systems issues with a partnership of experts committed to the success of the Project.

2.0 BACKGROUND AND SCOPE

2.1 The HDSS Team proposes a comprehensive technical project and supporting management structure to develop high capacity, high data rate holographic data storage testbeds.

2.2 The research and development effort is broadly divided into two principal efforts. The first one addresses the development of components required for advanced holographic data storage systems including laser sources, high resolution SLM and CCDE arrays, and optical components for system integration. The second effort addresses the integration of these components into four testbed devices. Two groups of partners are each producing two testbeds, one ROM device and one erasable device with application for either data storage, military avionics or telecommunications.

2.3 The component development effort is focused on producing; (1) a high capacity (at lease 1024x1024), high bandwidth (at least 1000 fps) spacial light modulator for use as a data input device; (2) an optimized CCD sensor array (at least 1024x1024 elements) and associated circuitries to permit high frame rate transfer

(at least 1000 fps); (3) a high power visible laser diode source in the red region of the spectrum, which can be used in conjunction with a turnable cavity for frequency agile recording and readout of holograms.

2.4 The system integration effort will focus on developing four testbeds. Each testbed will be optimized for a particular application. Three areas of application are chosen; telecommunications, military avionics, and data storage. At least three different architectures will be integrated and tested early in the program, namely those based on angular, wavelength and phase encoding. One, or possibly two, of these architectures will be selected for subsequent use in the four testbeds.

2.5 Signal processing issues specific to HDSS will be investigated with emphasis on the unique properties and requirements of HDSS related to the parallel recording and readout of image data pages. Included in this effort will be the development of 2-D data coding schemes, error detection algorithms, and correction schemes.

2.6 The building blocks will be tested in two testbeds. The WORM system will be operation at the end of the third year and the erasable system at the end of the fifth year.

2.7 The HDSS Team shall accomplish this research and development effort in accordance with an approved Project Plan. The initial Project Plan is contained in the HDSS Gantt Chart. Subsequent project planning shall be accomplished in accordance with Article III of this Agreement.

3.0 SPECIFIC TASKS

(Note that numbers are keyed to Payable Events Schedule, Attachment 3)

3.1 SYSTEMS ARCHITECTURE & PERFORMANCE - The HDSS Team shall; (1) establish and operate a model to study HDSS system performance, (2) define systems architecture and performance requirements for selected data storage applications, (3) define systems architecture and performance requirements for selected telecommunication applications, (4) define systems architecture and performance requirements for selected military and commercial avionics applications.

3.2 SPACIAL LIGHT MODULATOR - The HDSS Team shall; (1) define the operating parameters for a liquid crystal spatial light modulator (SLM) for use in a holographic storage testbed, (2) design 1st generation devices, (3) fabricate prototypes of the 1st generation design, (4) test 1st generation prototypes in PRISM testbed, (5) design 2nd generation devices, (6) fabricate prototypes of 2nd generation devices, (7) test 2nd generation prototypes, (8) design 3rd generation devices, (9) fabricate prototypes of 3rd generation devices, (10) test 3rd generation design and, (11) integrate devices into storage testbeds.

3.3 IMAGE SENSOR ARRAY - The HDSS Team shall; (1) incorporate existing image sensor arrays into suitable experiments/teststands, (2) determine the operating parameters of a custom array for use in an HDSS architecture, (3) design 1st generation MOS diode image sensor array, (4) fabricate prototypes of the 1st generation design, (5) test electronic design and fabrication, (6) test 1st generation prototypes, (7) perform design iterations as required and, (7) integrate arrays into testbeds.

3.4 LASER SOURCE - The HDSS Team shall; (1) design and fabricate the DBR master oscillator used in the M-MOPA configuration demonstrate a single spectral and spatial mode DBR laser diode that operates reliably to greater than 30 mW cw, (2) study the performance of the flared gain region to be used in the amplifier region and fabricate devices that operate in a single-spatial, multi-spectral mode at powers in excess of 300 mW cw, (3) integrate the master oscillator and flared power amplifier into an M-MOPA and fabricate devices that operate in single spatial and spectral modes with powers in excess of 300 mW cw, (4) develop an appropriate packaging technology to stigmate, circularize and collimate the output beam and, (5) improve M-MOPA technology and analyze manufacturing yields to assure the development a mature laser technology for data storage applications.

3.5 OPTICAL COMPONENTS - The HDSS Team shall; (1) identify innovative optical designs that minimize optical cost and complexity, (2) fabricate diffractive optical elements/devices for use in HDSS architecture, (3) develop a model for designing random phase masks, (4) evaluate mask fabrication methods and, (5) design, fabricate and evaluate random phase masks performance at a systems level.

3.6 FLEXURE-BEAM MICROMIRROR - The HDSS Team shall; (1) design flexure-beam micromirror (FBM) phase SLM device for use as reference beam phase-encoders, (2) fabricate first generation prototype devices, (3) perform experimental characterization, (4) optimize the performance to achieve the desired phase modulation, (5) design and fabricate second generation devices and, (6) evaluate functional performance in selected teststands/testbeds.

3.7 SIGNAL PROCESSING - The HDSS Team shall; (1) develop novel 1st generation signal processing strategies based on 2-dimensional block data architecture, (2) perform preliminary software simulations, (3) identify hardware costs and trade-offs, (4) design 1st generation signal processing devices, (5) fabricate 1st generation devices, (6) test 1st generation devices, (7) perform advanced software simulations, (8) design 2nd generation signal processing devices, (9) fabricate 2nd generation devices, (10) test 2nd generation devices, and (11) integrate into storage testbeds.

3.8 MULTIPLEXING METHODS - The HDSS Team shall; (1) design and implement proof-of-principle demonstrations to compare and evaluate hologram multiplexing techniques and, (2) understand trade-offs between complexity cost and manufacturability.

3.9 STORAGE TESTBEDS - The HDSS Team shall evaluate the functional performance of holographic storage through the; (1) design of selected write-once-read-many (WORM) testbeds, (2) implementation of WORM testbeds, (3) perform appropriate functional evaluation, (4) design of selected erasable testbeds, (5) implementation of erasable testbeds and, (6) perform appropriate function evaluation.

REPORT REQUIREMENTS

A. QUARTERLY REPORT

On or before ninety (90) calendar days after the effective date of the Agreement and quarterly thereafter throughout the term of the Agreement, the HDSS Team shall submit or otherwise provide a quarterly report. Two (2) copies shall be submitted or otherwise provided to the ARPA Program Manager, one (1) copy shall be submitted or otherwise provided to the ARPA Agreements Administrator and one (1) copy shall be submitted or otherwise provided to ARPA/DSO, Attn: Assistant Director for Program Management. The report will have two (2) major sections.

1. Technical Status Report. The technical status report will detail technical progress to date and report on all problems, technical issues or major developments during the reporting period. The technical status report will include a report on the status of HDSS Team collaborative activities during the reporting period.

2. Business Status Report. The business status report shall provide summarized details of the resources which describes the Annual Project Plan as described in Article III, Section B. This document shall be submitted not later than thirty (30) calendar days following the Annual Site Review as described in Article III, Section B.

B. ANNUAL PROJECT PLAN DOCUMENT

The HDSS Team shall submit or otherwise provide the ARPA Project Manager one (1) copy of a report which describes the Annual Project Plan as described in Article III, Section B. This document shall be submitted not later than thirty (30) calendar days following the Annual Site Review as described in Article III, Section B.

C. SPECIAL TECHNICAL REPORTS

As agreed to by the HDSS Team and the ARPA Project Manager, the HDSS Team shall submit or otherwise provide to the ARPA Project Manager, one (1) copy of special reports on significant events such as significant target accomplishments by HDSS Team Members, significant tests, experiments, or symposia.

D. PAYABLE EVENTS REPORTS

The HDSS Team shall submit or otherwise provide to the ARPA Project Manager, documentation describing the extent of accomplishment of Payable Events. This information shall be as required by Article V, paragraph B and shall be sufficient for

the ARPA Project Manager to reasonably verify the accomplishment of the milestone of the event in accordance with the Statement of Work.

E. FINAL REPORT

1. The HDSS Team shall submit or otherwise provide a Final Report making full disclosure of all major developments by the HDSS Team within sixty (60) calendar days of completion or termination of this Agreement. With the approval of the ARPA Program Manager, reprints of published articles may be attached to the Final Report. Two (2) copies shall be submitted or otherwise provided to the ARPA Project Manager and one (1) copy shall be submitted or otherwise provided to ARPA/DSO, Attn: Attn: Assistant Director for Program Management. One (1) copy shall be submitted to the Defense Technical Information Center (DTIC) addressed to Building 5/Cameron Station, Alexandria, VA 22134.

2. The Final Report shall be marked with a distribution statement to denote the extent of its availability for distribution, release, and disclosure without additional approvals or authorizations. The Final Report shall be marked on the front page in a conspicuous place with the following marking:

> "DISTRIBUTION STATEMENT B, Distribution authorized to U.S. Government agencies only to protect information not owned by the U.S. Government and protected by a contractor's "limited rights" statement, or received with the understanding that it not be routinely transmitted outside the U.S. Government. Other requests for this document shall be referred to ARPA/S&IO (Attn: Technical Information Center)."

PAYABLE EVENTS SCHEDULE

MILESTONES	STATEMENT OF WORK Task Item	ARPA PAYMENT
1Q		$697,029
SLM parameters defined	3.2(1)	
Existing sensor arrays available	3.3(1)	
Custom sensor array parameters defined	3.3(2)	
1st gen FBM parameters defined	3.6(1)	
2Q		$616,603
Report of 1st gen SLM design	3.2(2)	
FBM and image sensor design	3.6(1)	
Random phase mask model operational	3.5(3)	
Novel 1st gen sig proc strategies developed	3.7(1)	
3Q		$723,838
Optical design options defined	3.5(1)	
Random phase mask fab methods evaluated	3.5(4)	
1st gen FBM fab completed	3.6(2)	
Prelim sig proc software simul perf	3.7(2)	
Angular MUX eval system ready	3.8(1)	
4Q		$642,411
Report on 1st generation data storage systems	3.1(2);3.1(3);3.1(4) 3.2(3);3.3(4)	
Report on fabrication of SLM and image sensor complete	3.2(3); 3.3(4)	
Report on DBR master oscillator design, fab and flaired gain region	3.4(1); 3.4(2)	
Sig proc hardware cost trade-off eval	3.7(3)	
Wavelength MUX eval system ready	3.8(1)	
5Q		$829,433
Systems architecture model established	3.1(1)	
Image sensor test elec ready	3.3(5)	
1st gen signal processing design complete	3.7(4)	
Phase MUX eval system ready	3.8(1)	
Selection of WORM material system	3.9(1)	
6Q		$973,682
Report on testing of improved 1st generation systems components	3.2(4);3.3(6) 3.5(2); 3.5(5); 3.6(3)	
Preliminary MUX trade-off analysis	3.8(2)	

7Q		$865,495
	1st gen FBM performance optimized	
	1st gen sig proc devices fab complete	3.6(4)
	Selection of MUX for WORM	3.7(5)
	WORM Design Review - optics	3.9(1)
	WORM Design Review - electronics	3.9(2)
	WORM Design Review - optomechanics	3.9(2)
8Q		$937,620
	Report on 2nd gen SLM design and 2nd gen image sensor design	3.2(5);3.3(7)
	Improved laser device developed	3.4(3);3.4(4)
	Report on 2nd gen FBM design complete	3.6(5)
	MUX study complete	3.8(2)
	WORM system design finalized	3.9(1)
9Q		$1,067,365
	Report on 2nd gen diffractive optical elements	3.5(2)
	1st gen sig proc device test complete	3.7(6)
	Preliminary design of R/W system arch	3.9(4)
	Selection of fixing method	3.9(4)
10Q		$886,839
	Report on 2nd generation SLM image sensor and FBM fabrication	3.2(6);3.3(7) 3.6(5)
	Adv software simulation complete	3.7(7)
	WORM system assembly complete	3.9(2)
11Q		$1,002,514
	1st gen sys model operational	3.1(1)
	2nd gen random phase mask evaluated	3.5(5)
	2nd gen sig proc devices designed	3.7(8)
	Lab Demo of R/W at single spatial loc	3.9(5)
12Q		$925,398
	Report on 2nd generation data storage system architecture	3.1(2);3.1(3) 3.1(4)
	Report on 2nd gen SLM test and 2nd gen image sensor test	3.2(7);3.3(7)
	Laser manufacturability eval complete	3.4(5)
	Report on 3rd gen diffractive optical elements and FMB performance eval	3.5(2);3.6(6)
	WORM System Demo	3.9(2)

13Q			$821,403
	3rd gen SLM design complete	3.2(8)	
	R/W Design Review - electronics	3.9(4)	
	R/W Design Review - optics	3.9(4)	
	R/W Design Review - optomechanics	3.9(4)	
14Q			$924,079
	2nd gen sig proc devices fab complete	3.7(9)	
	WORM system analysis complete	3.9(3)	
	R/W system design finalized	3.9(4)	
15Q			$725,953
	3rd gen SLM fab complete	3.2(9)	
	FBM integration into testbeds complete	3.6(6)	
16Q			$924,079
	3rd gen SLM test complete	3.2(10)	
	2nd gen sig proc device test complete	3.7(10)	
17Q			$648,117
	SLM testbed integration complete	3.2(11)	
	Image sensor/testbed integration complete	3.3(8)	
	Sig proc device integration complete	3.7(11)	
	R/W system assembled	3.9(5)	
18Q			$673,045
	R/W system debugged	3.9(5)	
19Q			$598,262
	2nd gen sys model complete	3.1(1)	
	R/W system demo	3.9(5)	
20Q			$573,333
	R/W functional evaluation	3.9(6)	
	Final Report	3.1 through 3.9	
		TOTAL	$16,084,498

FUNDING SUMMARY ($)

COMPANY/ UNIVERSITY	EQUIPMENT*	IR&D	CASH	IN-KIND	ARPA	TOTALS
GTE		$2,034,905			$1,780,190	$3,815,095
IBM			$4,979,836		3,820,037	8,799,873
KODAK	$346,000		1,316,961		1,662,976	3,325,937
OPTITEK			824,259		713,231	1,537,490
RPC		773,653		$136,938	700,409	1,611,000
ROCKWELL		2,530,715			1,969,285	4,500,000
SLD			1,000,716		799,314	1,800,030
CMU			435,200		347,970	800,000
STANFORD			234,272	137,500	1,463,088	1,834,860
U. OF ARIZONA		440,300	32,414		419,232	891,946
U. OF DAYTON		413,000	431,000		669,000	1,513,000
NSIC					503,388	503,388
LOWER TIER					1,236,378	1,236,378
TOTALS	$346,000	$6,192,573	$9,254,658	$274,438	$16,084,498	$32,168,997

*** All new equipment donated to participants for project.**

ATTACHMENT 5

HDSS BOARD MEMBERSHIP

The HDSS Board comprises one representative of each HDSS member, one ARPA representative and outside consultants as appropriate. These are:

Voting Members:

Optitek	Lambertus Hesselink
IBM	Glenn Sincerbox
GTE	Ralph Witherspoon
Eastman Kodak	Tomasz Jagielinski
Rochester Photonics	Mike Morris
Rockwell International	John Hong
SDL	David Welch
SRI	Ravinder Kachru
Stanford University	Lambertus Hesselink
University of Arizona	Ray Kostuk
University of Dayton	Steve Gustafson
ARPA	L. N. Durvasula
NSIC	Dale Hollabaugh

Non-Voting:

Outside Consultants: To be determined (5)

The Board shall be responsible for the coordination of the activities required to be performed by the Participants under the TDA. A simple majority of the voting members of the Board shall constitute a quorum. Resolutions of the Board shall be passed by the vote of a simple majority of Board members present at a Board meeting where a quorum exists. Resolutions of the Board may be adopted by all the voting members in writing. Board meetings can be conducted by teleconferencing through which each member can hear all the others at the same time.

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